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CHAMBERLAIN CREEK ELK-LOGGING STUDY

Progress Report for the 1981 Field Season

School of Forestry

University of Montana

March 25, 1982

Submitted to the

Bureau of Land Management

By: C. Les Marcum
W. Daniel Edge

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CHAMBERLAIN CREEK STUDY

Progress Report for the Period January 1 - December 31, 1981

INTRODUCTION

Generally, the objectives of this study are to describe elk distribution and elk use of several available environmental factors before, during and after logging in Chamberlain Creek in western Montana. The study has been conducted by personnel of the School of Forestry, University of Montana since 1975, under contract to the Bureau of Land Management. Additional funding is provided through the McIntire-Stennis Federal Forestry Program administered through the Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana; and by the Timber and Land Department of the Burlington Northern Company.

The levels of human disturbance increased substantially in the core study area (CSA) during 1981. All spur roads in the CSA were completed. Logging on BLM units started during August 1981, and continued until the week before opening of the general hunting season in October. Burlington Northern initiated logging on two units on the west side of the CSA in early December 1981. Logging in the CSA will continue during 1982.

Graduate student John F. Lehmkuhl completed his thesis, covering telemetry results from 1977 through 1979, during spring 1981. Since 1979, graduate student W. Daniel Edge has continued the telemetry studies.

STUDY AREALocation and Physiography

The study area is located in the northern Garnet Mountains of western Montana approximately 35 miles (56 km) east of Missoula (Fig. 1). Radio-collared elk have used an area of approximately 72 mi² (186 km²). The core study area (CSA), where logging is planned, is 5,800 acres (2,350 ha) in size.

Elevations range from approximately 3,800 feet (1,160 m) along lower Elk Creek to 6,860 feet (2,090 m) at Chamberlain Mountain. Elevations within the CSA range from 4,400 feet (1,340 m) to 6,800 feet (2,070 m).

Land-Use Practices

Prior to, and during the first years of this study human impact on the CSA was minimal. Two small clearcuts occurred in the southwest corner of the area, and a larger clearcut was located at the northwest corner. However, the main portion of the CSA had never been logged and was essentially roadless. Construction of the main contract road into

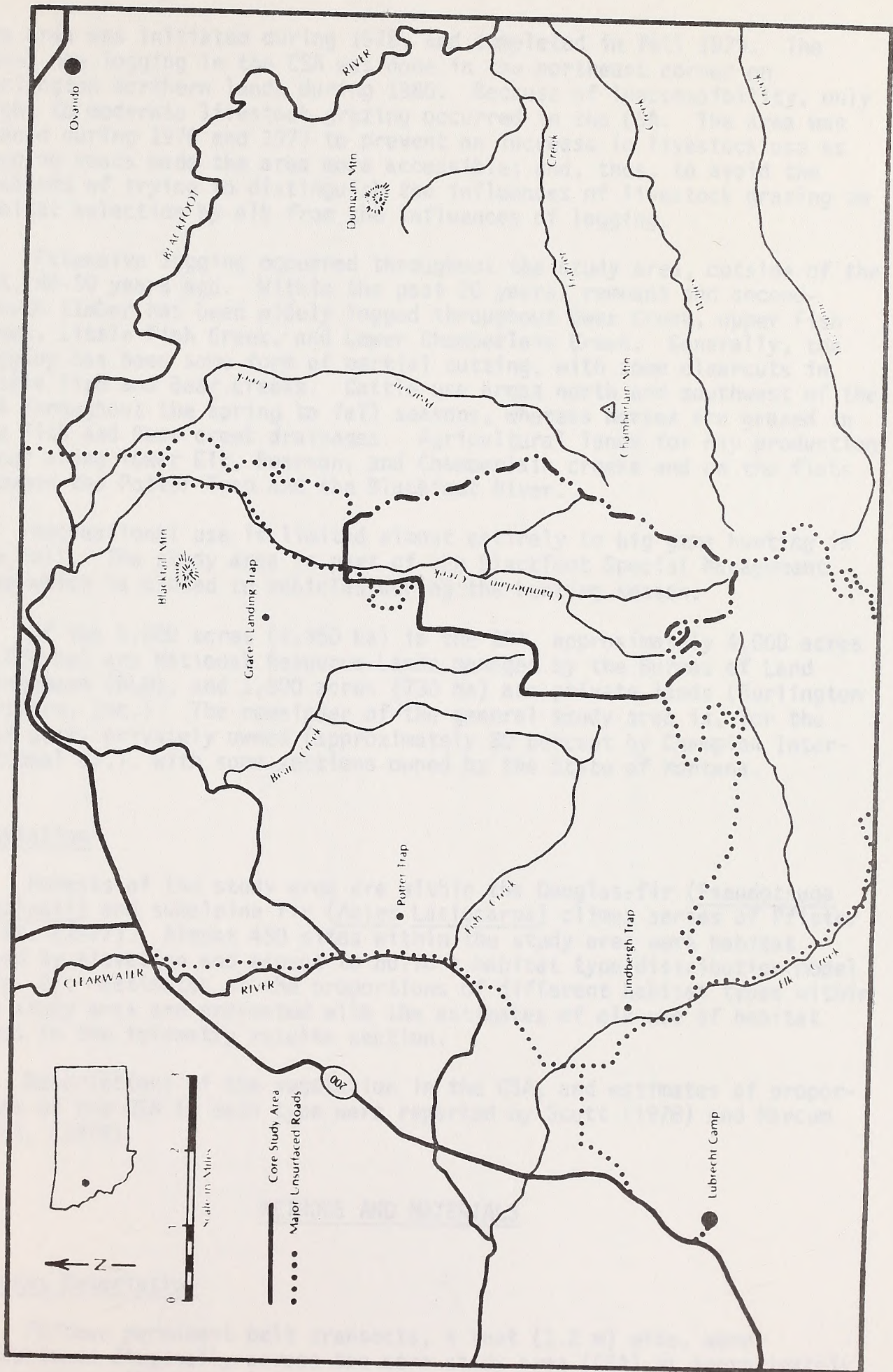


Figure 1. Map of the study area.

the area was initiated during 1978, and completed in fall 1979. The first new logging in the CSA was done in the northeast corner on Burlington Northern lands during 1980. Because of inaccessibility, only light to moderate livestock grazing occurred in the CSA. The area was fenced during 1976 and 1977 to prevent an increase in livestock use as logging roads made the area more accessible; and, thus, to avoid the problems of trying to distinguish the influences of livestock grazing on habitat selection by elk from the influences of logging.

Extensive logging occurred throughout the study area, outside of the CSA, 40-50 years ago. Within the past 20 years, remnant and second-growth timber has been widely logged throughout Bear Creek, upper Fish Creek, Little Fish Creek, and Lower Chamberlain Creek. Generally, the logging has been some form of partial cutting, with some clearcuts in Little Fish and Bear creeks. Cattle use areas north and southwest of the CSA throughout the spring to fall seasons, whereas horses are grazed in the Fish and Bear creek drainages. Agricultural lands for hay production occur along lower Elk, Pearson, and Chamberlain creeks and on the flats between the Potter Trap and the Blackfoot River.

Recreational use is limited almost entirely to big game hunting in the fall. The study area is part of the Blackfoot Special Management Area which is closed to vehicles during the hunting season.

Of the 5,800 acres (2,350 ha) in the CSA, approximately 4,000 acres (1,620 ha) are National Resource Lands managed by the Bureau of Land Management (BLM), and 1,800 acres (730 ha) are private lands (Burlington Northern, Inc.). The remainder of the general study area is, for the most part, privately owned (approximately 80 percent by Champion International Co.), with some sections owned by the State of Montana.

Vegetation

Forests of the study area are within the Douglas-fir (*Pseudotsuga menziesii*) and subalpine fir (*Abies lasiocarpa*) climax series of Pfister et al. (1977). Almost 450 sites within the study area were habitat typed by elevation and aspect to build a habitat type distribution model (Fig. 2). Estimates of the proportions of different habitat types within the study area are presented with the estimates of elk use of habitat types in the telemetry results section.

Descriptions of the vegetation in the CSA, and estimates of proportions of the CSA in each type were reported by Scott (1978) and Marcum et al. (1979).

METHODS AND MATERIALS

Habitat Description

Fifteen permanent belt transects, 4 feet (1.2 m) wide, were established diagonally across the core study area (CSA) at approximately one-quarter mile (400 m) intervals. Each transect was divided into a

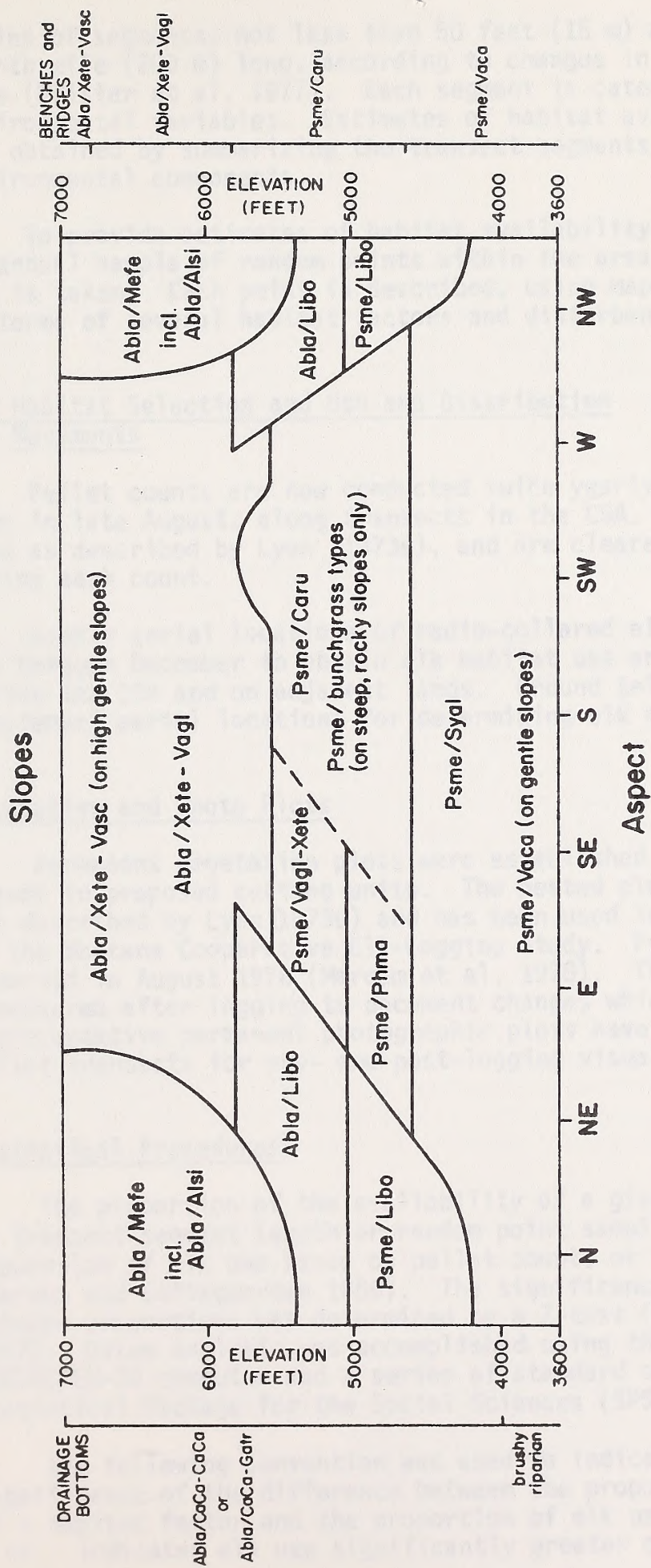


Figure 2. Habitat type distribution model for the entire study area.

series of segments, not less than 50 feet (15 m) and not greater than one-eighth mile (200 m) long, according to changes in cover and/or habitat type (Pfister et al. 1977). Each segment is categorized by a variety of environmental variables. Estimates of habitat availability in the CSA are obtained by summarizing the transect segments by the different environmental components.

To provide estimates of habitat availability for telemetry studies, an annual sample of random points within the area used by radio-collared elk is taken. Each point is described, using maps and aerial photographs, in terms of several habitat factors and disturbance relationships.

Elk Habitat Selection and Use and Distribution and Movements

Pellet counts are now conducted twice yearly, once in late June and once in late August, along transects in the CSA. Pellet groups are aged as described by Lyon (1973a), and are cleared from the transects during each count.

Weekly aerial locations of radio-collared elk are obtained from mid-May through December to obtain elk habitat use and movements data, both inside the CSA and on adjacent lands. Ground telemetry is used to supplement aerial locations for determining elk movements and distribution.

Vegetative and Photo Plots

Permanent vegetation plots were established in eleven representative stands in proposed cutting units. The nested plot sampling system used was described by Lyon (1973b) and has been used in other investigations of the Montana Cooperative Elk-Logging Study. Pre-logging results were reported in August 1978 (Marcum et al. 1978). These plots will be remeasured after logging to document changes which occur. Also, representative permanent photographic plots have been established along pellet transects for pre- and post-logging visual reference.

Statistical Procedures

The proportion of the availability of a given habitat factor, based on transect segment length or random point sampling, was compared to the proportion of elk use based on pellet counts or telemetry locations (Marcum and Loftsgaarden 1980). The significance of the difference between proportions was determined by a Z-test (Snedecor and Cochran 1967). Datum analysis was accomplished using the University of Montana DECSYSTEM-20 computer and a series of standard statistical programs, Statistical Package for the Social Sciences (SPSS, Nie et al. 1975).

The following convention was used to indicate the statistical significance of the difference between the proportion of availability of a habitat factor and the proportion of elk use of that factor; + or - indicates elk use significantly greater or less than availability,

$p < 0.05$; ++ or -- indicates a significant difference with $p \leq 0.01$; lack of a sign indicates no significant difference.

RESULTS

Results reported here are primarily from data collected during 1981. However, the results of the study to date will be considered in the discussion section. Data collected during previous years of this investigation are presented in previous annual reports, and in theses by Scott (1978) and Lehmkuhl (1981). Pellet and telemetry results are treated separately because they are not strictly comparable due to differences in technique, area and time periods considered, and sampling intensity per unit area.

Pellet Count Results

Transects have been cleared of all elk pellets during each survey since the August count of 1978. Since then, old and very old (OVO) pellet groups counted during the spring have been used to provide an estimate of fall elk use for the preceding year. Sample sizes for fall 1978, 1979, and 1980 were 355, 734, and 582 respectively. Only fresh and new (FN) pellet groups were used for spring and summer estimates of elk use. Sample sizes for spring counts were 127 during 1981, 77 during 1980, 118 during 1979, 82 during 1978, and 139 during 1977. The spring 1980 data were revised because of mistakes made in classifying pellet group ages on some transects. These data give fairly reliable estimates of spring distribution and habitat use by elk, but the total count will not now be used to predict future spring use. Summer sample sizes were 459 during 1981, 193 during 1980, 420 during 1979, 380 during 1978, 600 during 1977, and 201 during 1976.

Because of these substantial differences in sample size between counts, care must be used in interpreting the tabular data which are reported here in terms of proportions of elk use for various environmental categories. Changes in proportions within a category from one count to another do not necessarily reflect changes in the actual number of pellet groups counted for that category.

Elk distribution. The CSA was divided into 11 subunits based on topographic and vegetative homogeneity to identify yearly and seasonal shifts in elk distribution (Fig. 3). Table 1 shows percentages of elk use compared to availability for CSA subunits for fall 1980, and spring and summer 1981. Figures 4 through 6 show areas of actual elk use and non-use during the same seasons. Figures 7, 8, and 9 are composite maps of the consistency of elk use in the CSA for 3 falls, 5 springs, and 6 summers.

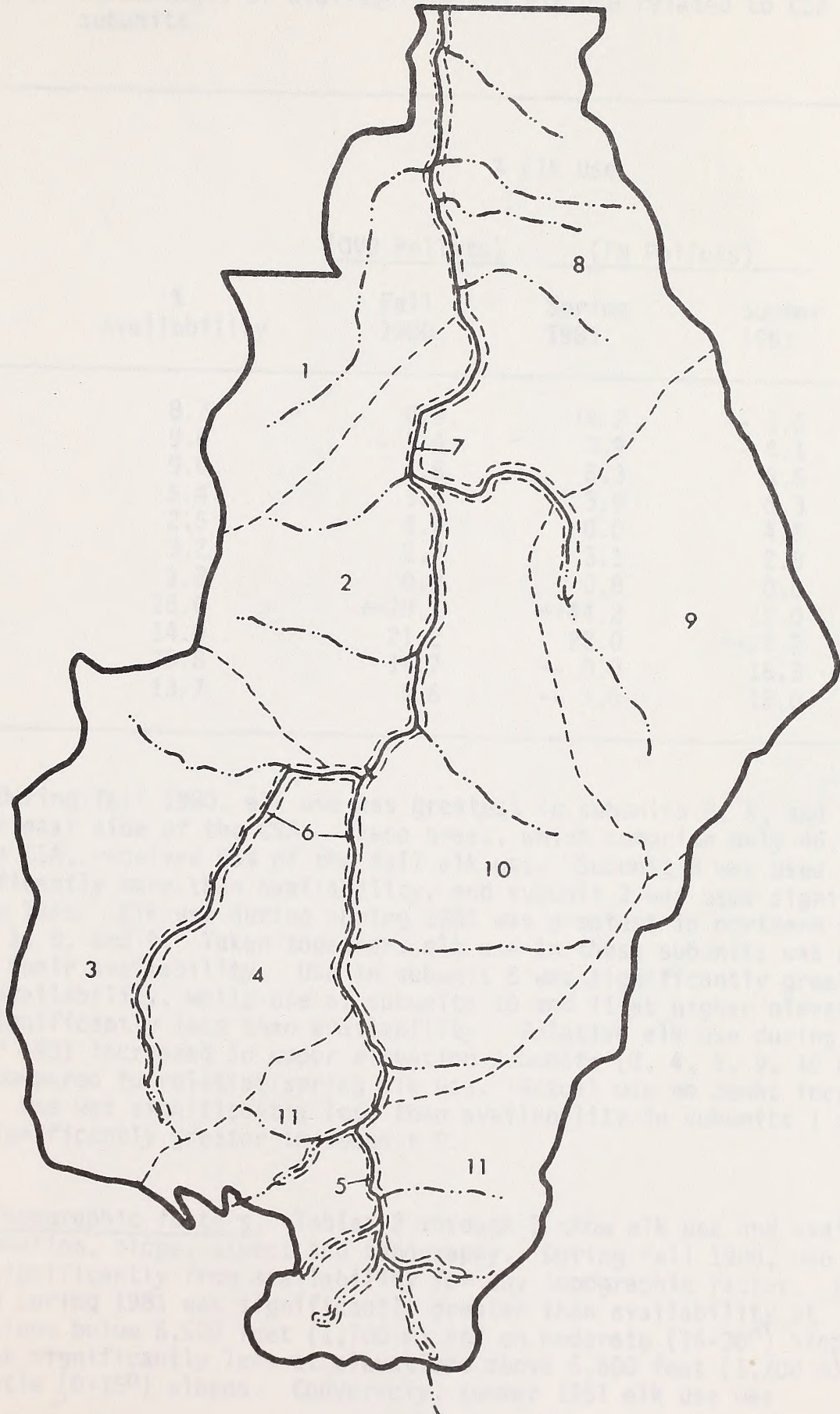


Figure 3. Map of subunits in the core study area.

Table 1. Percentages of availability and elk use related to CSA subunits.

Sub unit	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
1	8.7	8.9	14.2	-- 1.5
2	9.0	- 3.4	3.9	- 4.1
3	9.0	4.8	6.3	8.5
4	6.4	3.4	3.9	6.3
5	2.5	2.2	0.0	4.6
6	3.2	2.7	3.1	2.8
7	1.2	0.0	0.8	0.0
8	15.6	++29.1	++44.2	12.0
9	14.9	21.2	22.0	++29.9
10	15.8	14.7	-- 0.0	18.3
11	13.7	9.6	-- 1.6	12.0

During fall 1980, elk use was greatest in subunits 8, 9, and 10 on the east side of the CSA. These areas, which comprise only 46.3% of the CSA, received 65% of the fall elk use. Subunit 8 was used significantly more than availability, and subunit 2 was used significantly less. Elk use during spring 1981 was greatest in northern subunits 1, 8, and 9. Taken together, elk use in these subunits was over twice their availability. Use in subunit 8 was significantly greater than availability, while use of subunits 10 and 11 at higher elevations was significantly less than availability. Relative elk use during summer 1981 increased in upper elevation subunits (3, 4, 5, 9, 10 and 11) when compared to relative spring elk use. Actual use no doubt increased also. Use was significantly less than availability in subunits 1 and 2, and significantly greater in subunit 9.

Topographic factors. Tables 2 through 5 show elk use and availability by elevation, slope, aspect and topography. During fall 1980, use did not vary significantly from availability for any topographic factor. Elk use during spring 1981 was significantly greater than availability at elevations below 5,600 feet (1,700 m) and on moderate (16-30°) slopes, and was significantly less at elevations above 5,600 feet (1,700 m) and on gentle (0-15°) slopes. Conversely, summer 1981 elk use was



Figure 4. Areas of elk use and non-use in the CSA during fall 1980.



Figure 5. Areas of elk use and non-use in the CSA during spring 1981.



Figure 6. Areas of elk use and non-use in the CSA during summer 1981.

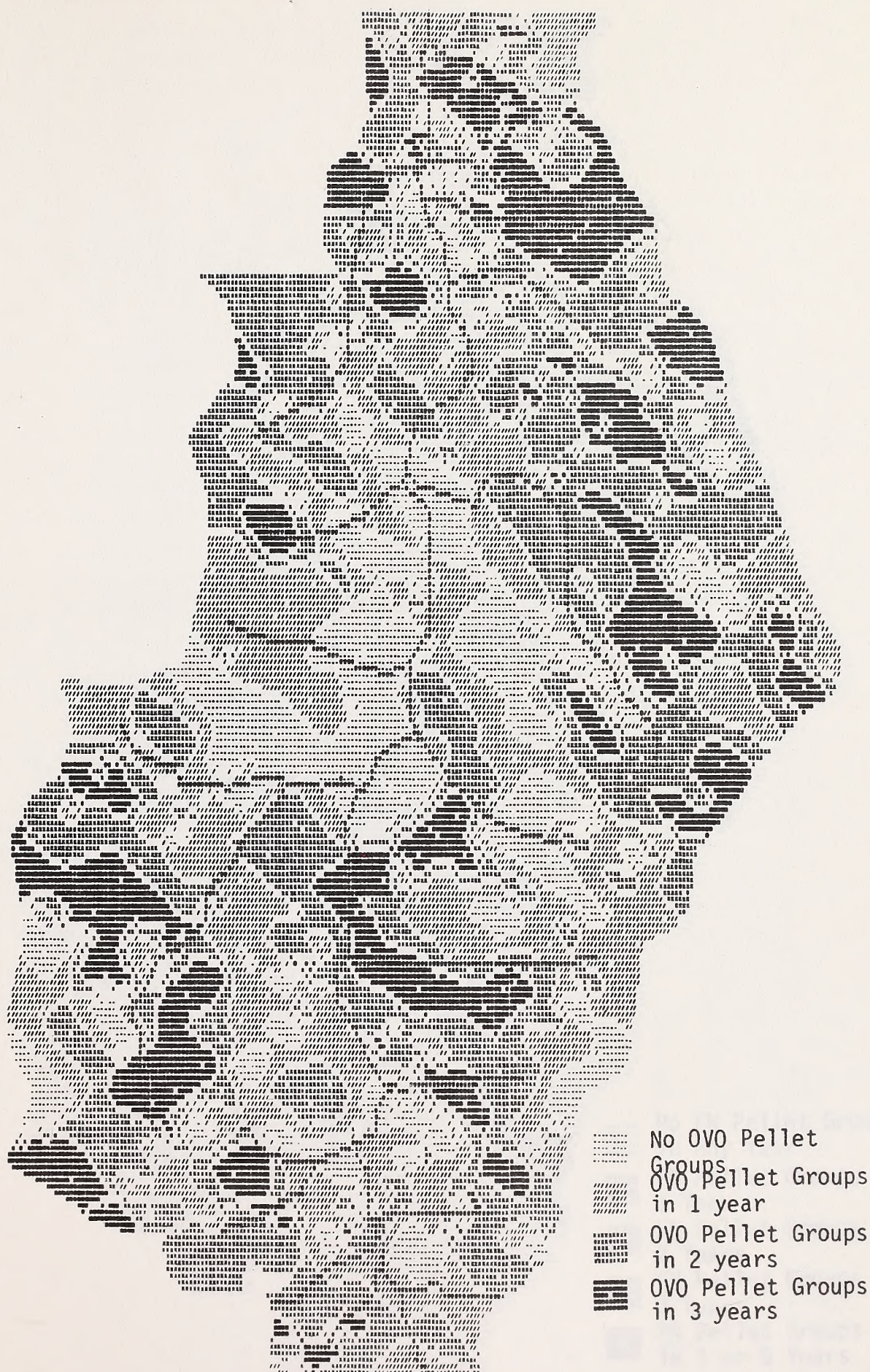


Figure 7. Consistency of CSA elk use for falls, 1978-1979-1980.

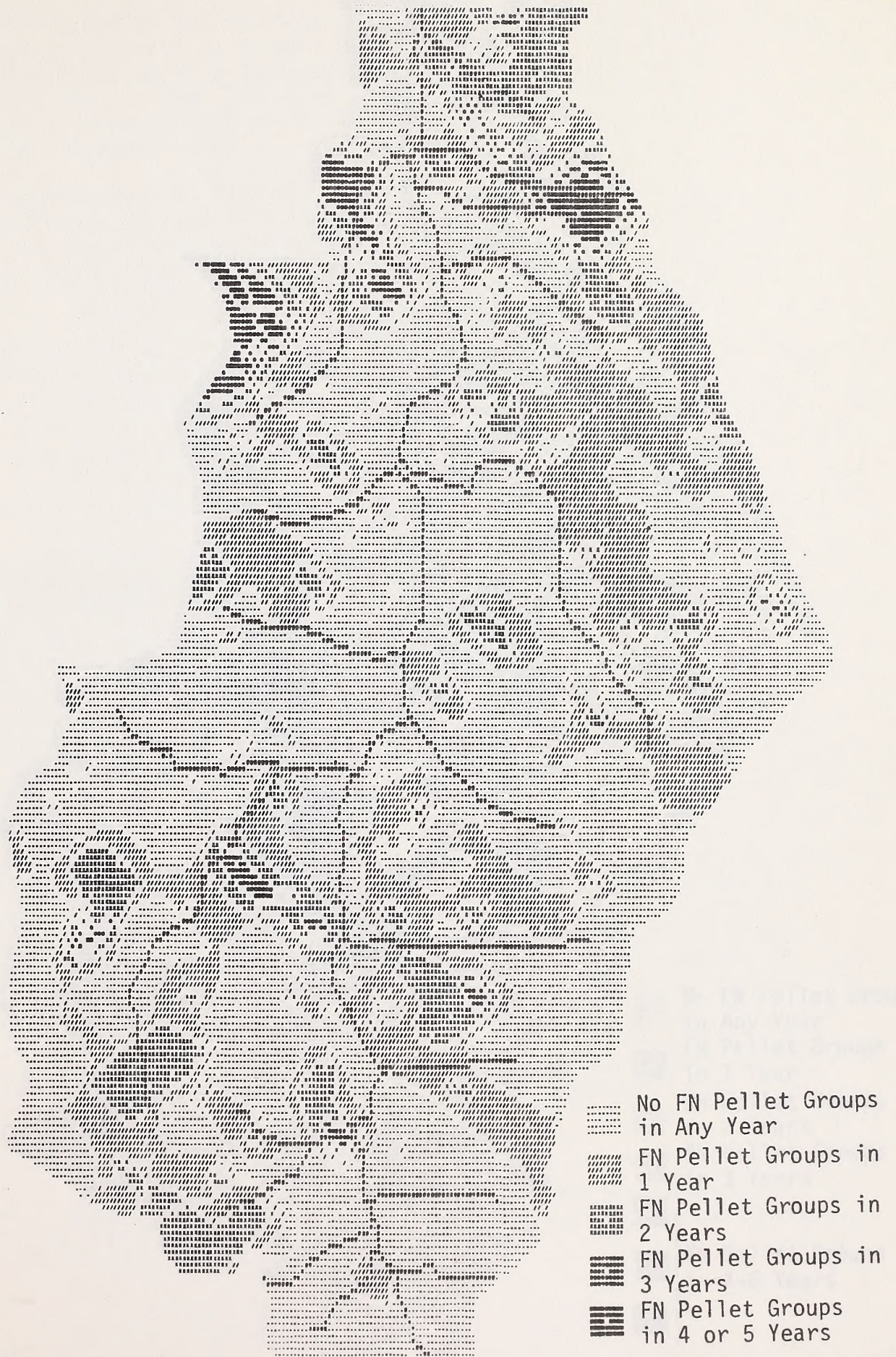


Figure 8. Consistency of CSA elk use for springs 1977 through 1981.

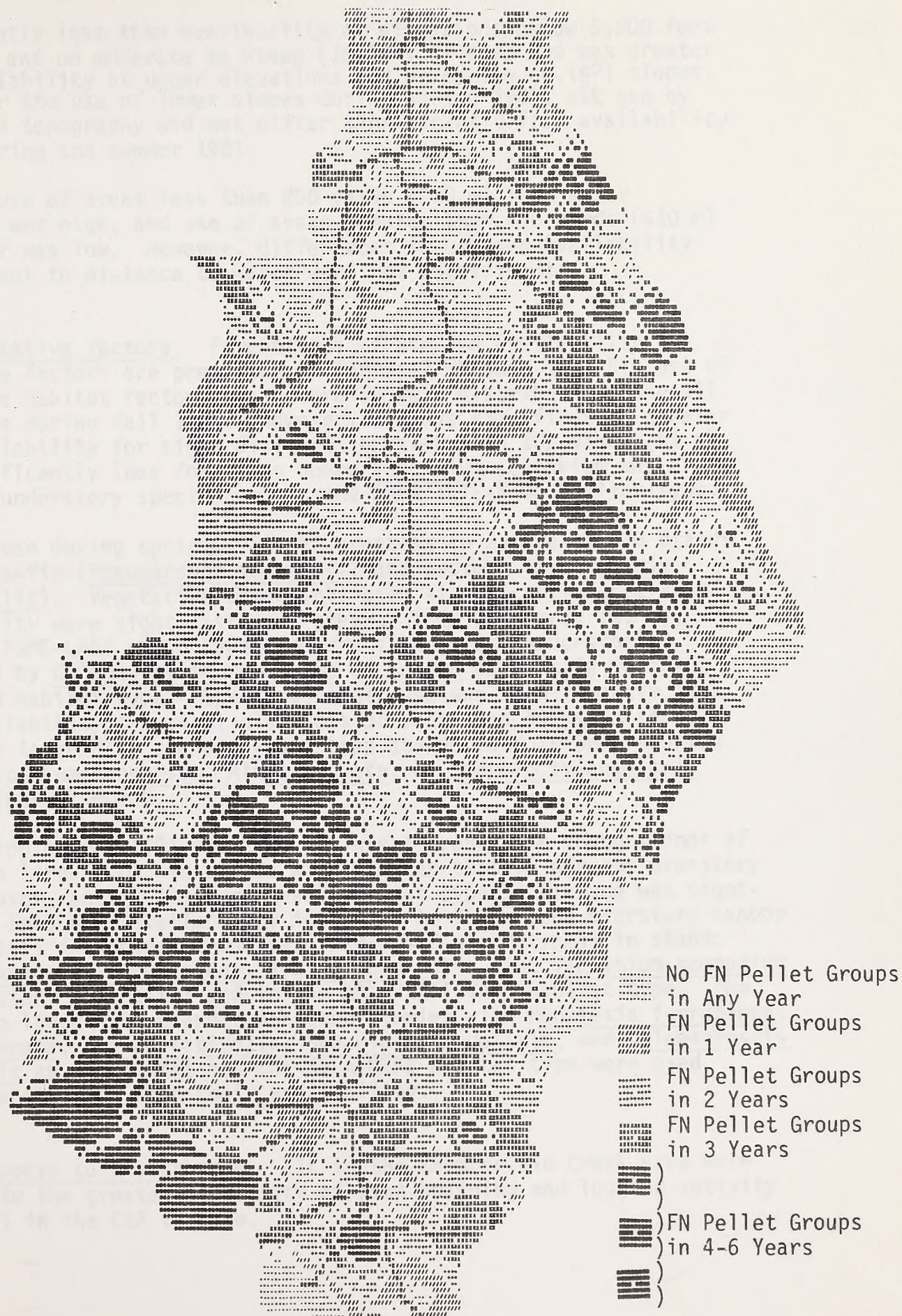


Figure 9. Consistency of CSA elk use for summers, 1976 through 1981.

significantly less than availability at elevations below 5,600 feet (1,700 m) and on moderate to steep (16-38°) slopes, and was greater than availability at upper elevations and on gentle (0-15°) slopes. Except for the use of lower slopes during spring 1981, elk use by aspect and topography did not differ significantly from availability during spring and summer 1981.

Elk use of areas less than 250 yards (230 m) from water (Table 6) was high, and use of areas greater than 450 yards (410 m) from water was low. However, differences in use and availability with respect to distance to water were not significant.

Vegetative factors. Percentages of use and availability for vegetative factors are presented in Tables 7 through 12. Elk use of vegetative habitat factors was generally well distributed among all components during fall 1980. However, use was significantly greater than availability for sight distances greater than 100 yards (91 m), and significantly less for sites where Vaccinium scoparium was a dominant understory species and in the ABLA/XETE-VAGL habitat type.

Elk use during spring 1981 was greatest in mature to old stands of Douglas-fir (Pseudotsuga menziesii) and western larch (Larix occidentalis). Vegetative components used significantly more than availability were sight distances greater than 100 yards (91 m), moderate PSME-LAOC stand types, mature stands, and understories dominated by Calamagrostis rubescens or Arnica cordifolia in the PSME/CARU habitat type. Spring 1981 elk use was significantly less than availability for sight distances of less than 50 yards (46 m), medium to large PICO stands, young tree stands, and in understories where Vaccinium scoparium, Alnus sinuata, or Senecio triangularis were dominant species.

During summer 1981 relative elk use increased in young stands of medium to large PICO, in stands with greater than 75 percent overstory canopy cover, and in the more mesic habitat types. Elk use was significantly less than availability in the 25 to 75 percent overstory canopy cover class; in dense and moderate PSME-LAOC stand types; in stands with Calamagrostis rubescens, Arnica cordifolia, and Vaccinium scoparium as understory dominants; and in the ABLA/XETE-VASC habitat type. The medium to large PICO stand type; understories with Menziesia ferruginea, Alnus sinuata, Arnica latifolia, Senecio triangularis, and Calamagrostis canadensis as dominants; and the ABLA/MEFE habitat type were used significantly more than their availability.

Response to disturbance. Elk in the Chamberlain Creek area were exposed to the greatest intensity of road building and logging activity (Fig. 10) in the CSA to date.

Table 2. Percentages of availability and elk use related to CSA elevation.

Elevation feet (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
4,500-5,000 (1,370-1,520)	9.1	8.9	+20.5	-- 3.5
5,100-5,600 (1,550-1,700)	22.5	26.9	+34.6	--12.0
5,700-6,200 (1,740-1,890)	50.2	46.0	-36.2	++61.0
6,300-6,800 (1,920-2,070)	18.2	18.2	-- 8.7	23.5

Table 3. Percentages of availability and elk use related to CSA slope.

Slope	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-15 ⁰	65.8	64.4	-52.7	++83.9
16-30 ⁰	30.3	32.0	++44.9	--15.0
31-38 ⁰	3.9	3.6	2.4	- 1.1

Table 4. Percentages of availability and elk use related to CSA aspect.

Aspect	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
N	9.2	9.3	11.0	11.5
NE	20.5	16.9	19.7	14.6
E	9.7	7.1	6.3	5.2
SE	6.2	3.6	2.4	4.8
S	2.3	0.9	0.0	2.2
SW	15.2	17.0	14.2	12.0
W	16.3	18.7	22.0	21.6
NW	20.6	26.5	24.4	28.1

Table 5. Percentages of availability and elk use related to CSA topography.

Topography	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
Main stream	4.0	3.1	0.8	3.7
Lower slope	6.6	5.2	--0.8	5.1
Mid-slope	47.3	52.2	52.8	53.6
Secondary upper slope and ridgetop	12.7	12.4	15.8	7.4
Primary upper slope and ridgetop	16.1	12.7	11.8	14.3
Bench	5.0	6.0	3.9	2.6
Swale	4.6	6.2	10.2	7.2
Other	3.7	2.2	3.9	6.1

Table 6. Percentages of availability and elk use related to distance to water in the CSA.

Distance to water yards (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-50 (0-45)	18.3	19.3	19.7	23.8
50-150 (45-140)	23.9	24.9	22.0	18.5
150-250 (140-230)	21.2	21.5	24.4	23.5
250-350 (230-320)	15.3	17.4	13.4	15.9
350-450 (320-410)	11.6	10.7	15.0	9.8
450-850 (410-780)	9.7	6.2	5.5	8.5

Table 7. Percentages of availability and elk use related to CSA overstory canopy cover.

Overstory canopy cover	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-25%	5.0	8.4	7.9	6.3
25-75%	46.4	46.3	51.2	-37.9
>75%	48.6	45.3	40.9	55.8

Table 8. Percentages of availability and elk use related to CSA sight distance.

Sight distance yards (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
<50 (<46)	32.0	32.9	--15.0	27.0
50-100 (46-91)	58.6	52.5	64.6	63.4
>100 (>91)	9.4	+14.6	+20.4	9.6

Table 9. Percentages of availability and elk use related to CSA tree stand type.

Tree stand type	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
Dense PSME-LAOC	9.6	11.2	14.2	--3.9
Moderate PSME-LAOC	11.0	9.8	++29.1	--5.2
Scattered large PSME	3.2	6.5	11.0	3.3
Clearing	4.0	7.2	4.7	5.9
Dense ABLA-PIEN	14.5	17.4	7.1	16.3
Moderate ABLA-PIEN	6.0	7.2	2.4	6.8
Small to medium PICO	8.4	5.0	5.5	6.1
Medium to large PICO	43.3	35.7	--26.0	+52.5

PSME - Pseudotsuga menziesii
 ABLA - Abies lasiocarpa
 PICO - Pinus contorta
 LAOC - Larix occidentalis
 PIEN - Picea Engelmanni

Table 10. Percentages of availability and elk use related to CSA successional stage.

Successional stage	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
Brush-seedling	1.8	1.2	0.8	3.3
Pole-sapling	3.3	1.5	0.8	1.1
Young stand	43.6	38.6	--21.2	50.7
Mature stand	26.5	27.0	++43.3	24.2
Old stand	22.7	27.7	25.2	18.7
New cut	2.1	4.0	8.7	2.0

Table 11. Percentages of availability and elk use related to CSA dominant understory species.

Dominant understory species	% Availability*	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
<u>Festuca idahoensis-</u>				
<u>Agropyron spicatum</u>	5.8	8.6	8.7	3.3
<u>Calamagrostis rubescens</u>	10.1	13.2	+22.0	-- 4.1
<u>Arnica cordifolia</u>	6.6	9.1	+16.5	- 2.6
<u>Xerophyllum tenax</u>	35.1	28.7	42.5	29.0
<u>Vaccinium scoparium</u>	17.1	-- 8.6	-- 3.9	-- 8.1
<u>Vaccinium globulare</u>	31.9	30.8	40.2	25.5
<u>Menziesia ferruginea</u>	23.1	27.0	18.9	+31.6
<u>Alnus sinuata</u>	27.7	28.7	--10.2	+37.3
<u>Arnica latifolia</u>	11.4	14.4	11.0	++20.5
<u>Senecio triangularis</u>	5.2	5.2	-- 0.8	++11.8
<u>Calamagrostis canadensis</u>	5.0	4.1	4.7	+10.0
Other	16.6	16.3	17.3	11.5

*Since the two dominant species on each segment were recorded, the percentages total to more than 100 percent.

Table 12. Percentages of availability and elk use related to CSA habitat types.

Habitat Type	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
PSME/FEID	2.5	3.6	3.9	2.2
PSME/CARU-AGSP	1.6	4.3	2.4	0.9
PSME/CARU ¹	4.7	5.5	+15.7	2.0
PSME/PHMA ²	0.6	1.4	0.8	0.0
PSME/VAGL-XETE ³	1.3	1.4	1.6	0.2
PSME/LIBO ⁴	1.1	1.5	3.9	0.2
PSME/SYAL ⁵	0.9	1.0	0.8	0.7
ABLA/LIBO	1.9	3.1	2.4	0.2
ABLA/LIBO-XETE	14.6	18.1	26.7	10.2
ABLA/XETE-VAGL ⁶	26.0	-17.7	15.0	22.4
ABLA/XETE-VASC	5.0	2.1	1.6	- 1.5
ABLA/MEFE	24.8	29.3	20.4	++36.3
ABLA/ALSI	4.0	2.2	0.8	5.7
ABLA/CLUN ⁷	1.3	1.4	0.0	2.4
ABLA/CACA-CACA	3.6	5.2	1.6	7.2
ABLA/CACA-GATR ⁸	2.5	0.3	0.8	1.5
ABLA/CACA-VACA ⁹	1.4	0.7	0.8	3.1
Clearcut	2.0	1.2	0.8	3.3
Rock	0.2	0.0	0.0	0.0

¹Includes ABLA/CARU

²Includes PSME/PHMA-CARU

³Includes PSME/VAGL

⁴Includes PSME/LIBO-SYAL, PSME/LIBO-VAGL, and PSME/LIBO-CARU

⁵Includes PSME/SYAL-CARU and PSME/SYAL-AGSP

⁶Includes ABLA/VAGL

⁷Includes ABLA/CLUN-ARNU and ABLA/CLUN-MEFE

⁸Includes ABLA/GATR

⁹Includes ABLA/VACA and wet meadows

All proposed roads within the CSA were completed during the 1981 field season. The south spur, running from the end of the main haul road to BLM cutting units 7 and 8; and the east side spur, running from the end of the main haul road to the east fork spur in BLM units 13-17, were pioneered between December 1980 and March 1981. That portion of the Lost Horse spur, beginning a short distance north of BLM unit 3, and ending in BLM units 5 and 6, was pioneered in mid-March 1981. Following spring break-up, about early May, work began on slash cleanup, laying drainage pipe, and grading to specification. Work was concentrated on the south and east spurs until early August. The Lost Horse spur was completed in late August.

Several logging units were entered during the 1981 field season. Logging began on the west side of BLM units 14-16 in mid-August. Two or three trucks, making three trips per day, began hauling logs in late August, and continued using both the main and east fork roads until the beginning of the general hunting season. The portions of BLM units 1 and 6 that were to be line-skidded were cut and hauled during the middle of September. About this same time, BN units 1-5 were reentered to finish the logging and clean-up work not completed in the fall of 1980. BLM unit 11 was cut and the logs hauled in late September to early October. After completing unit 11 the crews returned to BLM unit 1, where they worked until the beginning of the general hunting season. After the general hunting season, in early December, work began on falling and skidding trees in BN unit 8. The logs in this last unit will be hauled next summer. It is anticipated that all remaining cutting units will be entered and completed during the 1982 field season.

In terms of CSA subunits (Fig. 3); logging, road building, and hauling activities were greatest in subunits 1, 2, 3, 4, 8, 10, and 11. In some cases elk use was high in subunits with high levels of human activity, as in subunit 8 during fall 1980 and spring 1981 when use was significantly greater than availability. Conversely, use was low in subunits 10 and 11 during spring 1981, and in subunits 1 and 2 during summer 1981. Summer 1981 elk use was greatest in subunit 9, where human activities were low.

Following the pioneering of CSA spur roads during winter and early spring of 1981, elk use and availability values for distance to new and proposed roads are the same (Tables 13 and 14). Proportions of elk use were similar to availability for distances to new and proposed roads during fall 1980. During spring 1981 elk use within 550 yards (500 m) of the proposed (new) roads was high, and use was significantly greater than availability for the 150-550 yard (140-500 m) interval. Elk use was significantly less than availability during summer 1981 within 150 yards (140 m) of the proposed (new) roads. Similarly, use was significantly less than availability within 150 yards (140 m) of proposed cutting units (Table 15), some of which were being logged. No distinctive trends were noted in the distribution of elk use with respect to existing clearcuts and old roads in and near the CSA (Tables 16 and 17).

EXISTING CLEARCUT 
 BLM CUTTING UNIT 
 BN CUTTING UNIT 
 MAIN HAUL ROAD - - - - -
 SECONDARY HAUL ROAD - . - . -

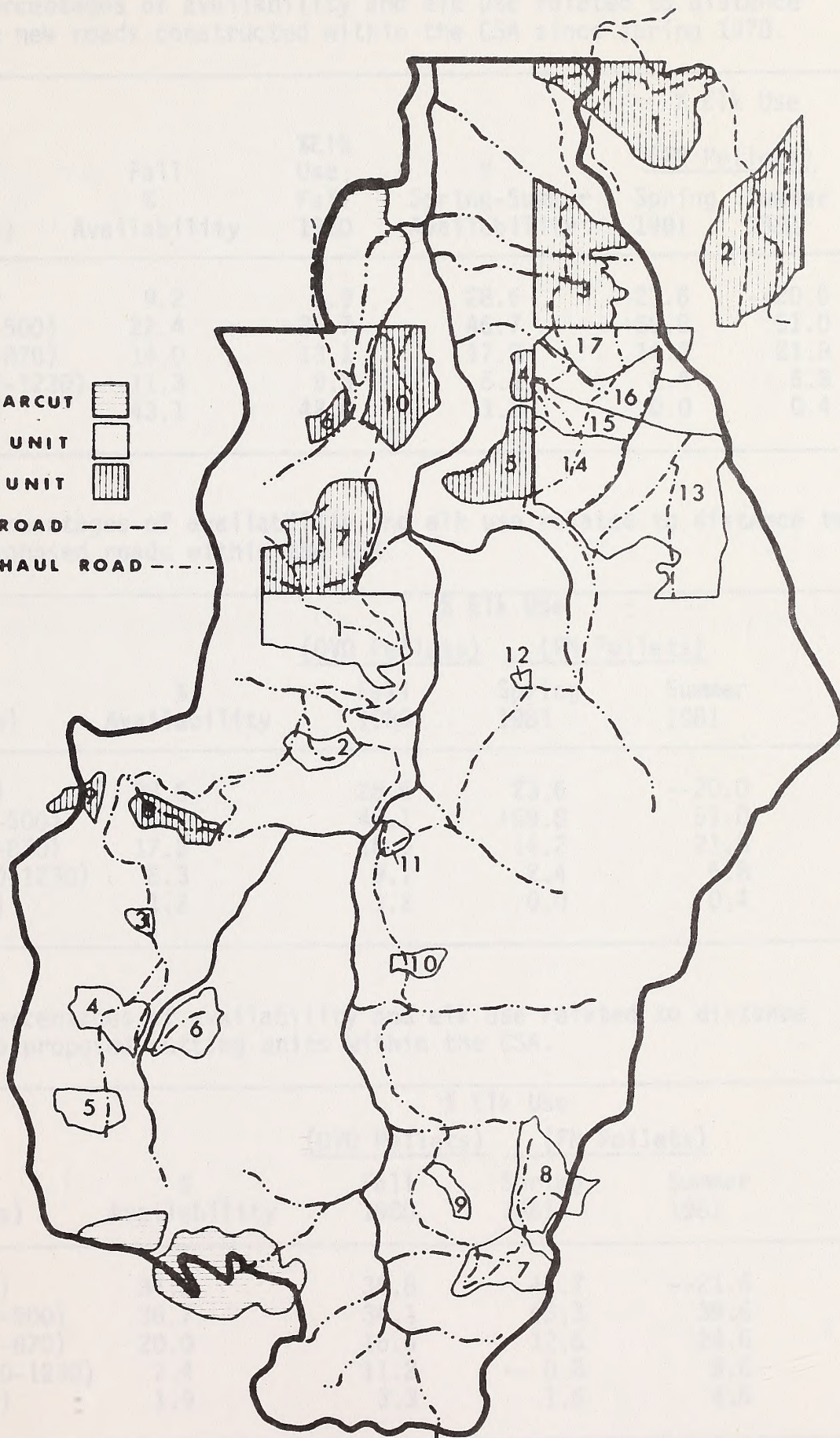


Figure 10. Map of existing clearcuts, planned cutting units, and planned roads in the CSA.

Table 13. Percentages of availability and elk use related to distance to new roads constructed within the CSA since spring 1978.

Distance yards (meters)	Fall % Availability	%Elk Use Fall 1980	% Spring-Summer Availability	% Elk Use (FN Pellets)	
				Spring 1981	Summer 1981
0-150 (0-140)	9.2	8.9	28.6	23.6	--20.0
150-550 (140-500)	22.4	26.7	46.7	+59.8	51.0
550-950 (500-870)	14.0	13.1	17.2	14.2	21.8
950-1350 (870-1230)	11.3	9.3	6.3	2.4	6.8
>1350 (>1230)	43.1	42.0	1.2	0.0	0.4

Table 14. Percentages of availability and elk use related to distance to proposed roads within the CSA.

Distance yards (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-150 (0-140)	28.6	28.6	23.6	--20.0
150-550 (140-500)	46.7	45.1	+59.8	51.0
550-950 (500-870)	17.2	16.0	14.2	21.8
950-1350 (870-1230)	6.3	9.1	2.4	6.8
>1350 (>1230)	1.2	1.2	0.0	0.4

Table 15. Percentages of availability and elk use related to distance to proposed cutting units within the CSA.

Distance yards (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-150 (0-140)	34.0	34.8	41.7	--21.6
150-550 (140-500)	36.7	34.1	43.3	39.6
550-950 (500-870)	20.0	16.6	12.6	24.6
950-1350 (870-1230)	7.4	11.2	-- 0.8	9.6
>1350 (>1230)	1.9	3.3	1.6	4.6

Table 16. Percentages of availability and elk use related to distance to existing clearcuts.

Distance to Existing Clearcuts Yards (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-150 (0-140)	6.1	4.1	7.1	5.7
150-550 (140-500)	11.6	13.2	11.0	8.7
550-950 (500-870)	15.5	13.6	25.2	14.4
950-1350 (870-1230)	15.5	16.9	18.9	14.2
>1350 (>1230)	51.3	52.2	-37.8	57.0

Table 17. Percentages of availability and elk use related to old roads in the CSA, constructed prior to spring 1978.

Distance to Road Yards (meters)	% Availability	% Elk Use		
		(OVO Pellets)	(FN Pellets)	
		Fall 1980	Spring 1981	Summer 1981
0-150 (0-140)	12.4	8.6	6.3	8.9
150-550 (140-500)	27.4	31.9	34.7	24.4
550-950 (500-870)	27.7	31.7	36.2	34.4
950-1350 (870-1230)	21.6	19.4	17.3	23.1
>1350 (>1230)	10.9	8.4	5.5	9.2

Future cutting units. A summary of pellet groups per 1,000 steps within proposed cutting units (Fig. 10) is shown in Table 18. Transect segments in BN cutting units may extend beyond cut boundaries, because the units were not delineated when the transects were installed. Results for those units are approximate. Also, four BN units were not sampled. Units 1 and 2 are outside the CSA, and units 4 and 9 are not crossed by a transect. Two other BN units (8 and 10) are only marginally sampled by the original transects, but a special transect was installed across unit 8. Results from the special transect are not included here.

In previous years, elk use of proposed cutting units has varied considerably, both seasonally and yearly (Marcum et al. 1979, Marcum and Lehmkuhl 1980, and Marcum and Edge 1981). However, use of proposed cutting units, especially those units in the northeast and southwest portions of the CSA, was generally higher than on areas where logging was not planned. During fall 1980 and spring 1981, elk use was low in proposed cuts in the southwest part of the CSA, but use remained relatively high in most BN and BLM units in the northeast part of the CSA. Fall 1981 elk use in BN unit 5 was almost three times as high as elk use on areas where logging is not planned, even though the unit was being logged during most of the period of pellet deposition. However, in summer 1981, elk use was again high in the southwest units, where only road building occurred, but use was relatively low in and near the northeast units, where both road building and logging activities took place during the period of pellet deposition. Elk use on proposed cuts during fall 1980 and spring 1981 was higher than use on areas where cutting is not planned, but this was not true for summer 1981.

Elk use in CSA related to precipitation. Cumulative precipitation from October through the following September for 1980-81 is compared to the 20-year mean, and the 6 previous years in Fig. 11. Precipitation data are from Lubrecht Experimental Forest of the University of Montana School of Forestry, located approximately seven miles west of the CSA (Steele 1981 and Goetz pers. comm.). During 1980-81 precipitation was much less than average through April. May was a wet month, but after a hot dry summer, cumulative precipitation for the year was still below the 20-year mean.

In previous reports we reported a significant negative correlation between precipitation and summer elk use of the CSA during periods of little or no human disturbance (Marcum et al. 1979, Marcum and Lehmkuhl 1980). After adding the pellet count and precipitation data for the disturbance years of 1980 (Marcum and Edge 1981) and 1981, a high correlation is still shown. Our best correlation ($r = -0.95$) is between summer pellet counts of even numbered lines (transects), for which we have seven years data, and cumulative precipitation from October through August (Fig. 12).

Table 18. Pellet groups per 1,000 steps in proposed CSA cutting units.

		Pellet Groups per 1,000 Steps		
		(OVO Pellets)	(FN Pellets)	
Cutting unit		Fall 1980	Spring 1981	Summer 1981
BLM				
	1	3.5	0.0	3.5
	2	0.0	0.0	0.0
	3	0.0	0.0	0.0
	4	3.3	0.8	6.5
	5	2.7	0.0	11.0
	6	3.9	3.9	19.3
	7	1.7	0.0	5.0
	8	2.9	0.0	1.4
	9	0.0	0.0	9.3
	10	0.0	0.0	13.0
	11	0.0	0.0	0.0
	12	0.0	0.0	37.7
	13	9.2	2.3	1.1
	14	23.0	0.0	3.0@
	15	5.4	2.7	5.4@
	16	21.3	0.0	4.3@
	17	15.5	9.5	2.4
BN				
	3	9.4@	7.4*	5.4*
	5	17.4@	0.0*	6.5*
	6	6.4	1.6	0.0
	7	4.0	2.4	3.2
	8	5.1	0.0	0.0
	10	11.0	8.8	2.2
CORE STUDY AREA		6.7	1.5	5.5
ALL CUTS		7.8	2.3	5.0
NON CUT		6.6	1.3	5.6

@ Logging occurred in unit during period of pellet deposition.

* Logging occurred in unit prior to period of pellet deposition.

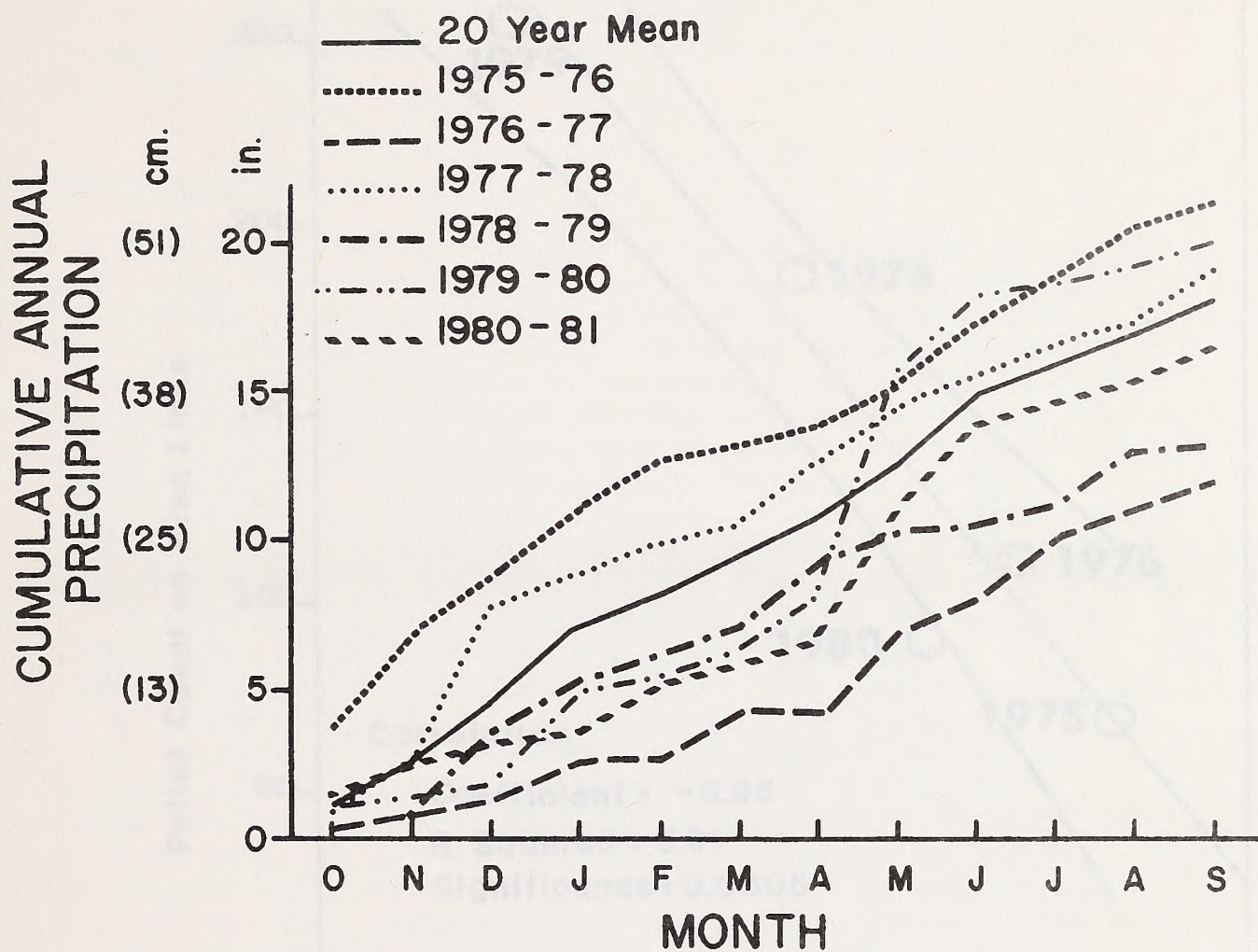


Figure 11. Cumulative annual precipitation at Lubrecht Experimental Forest.

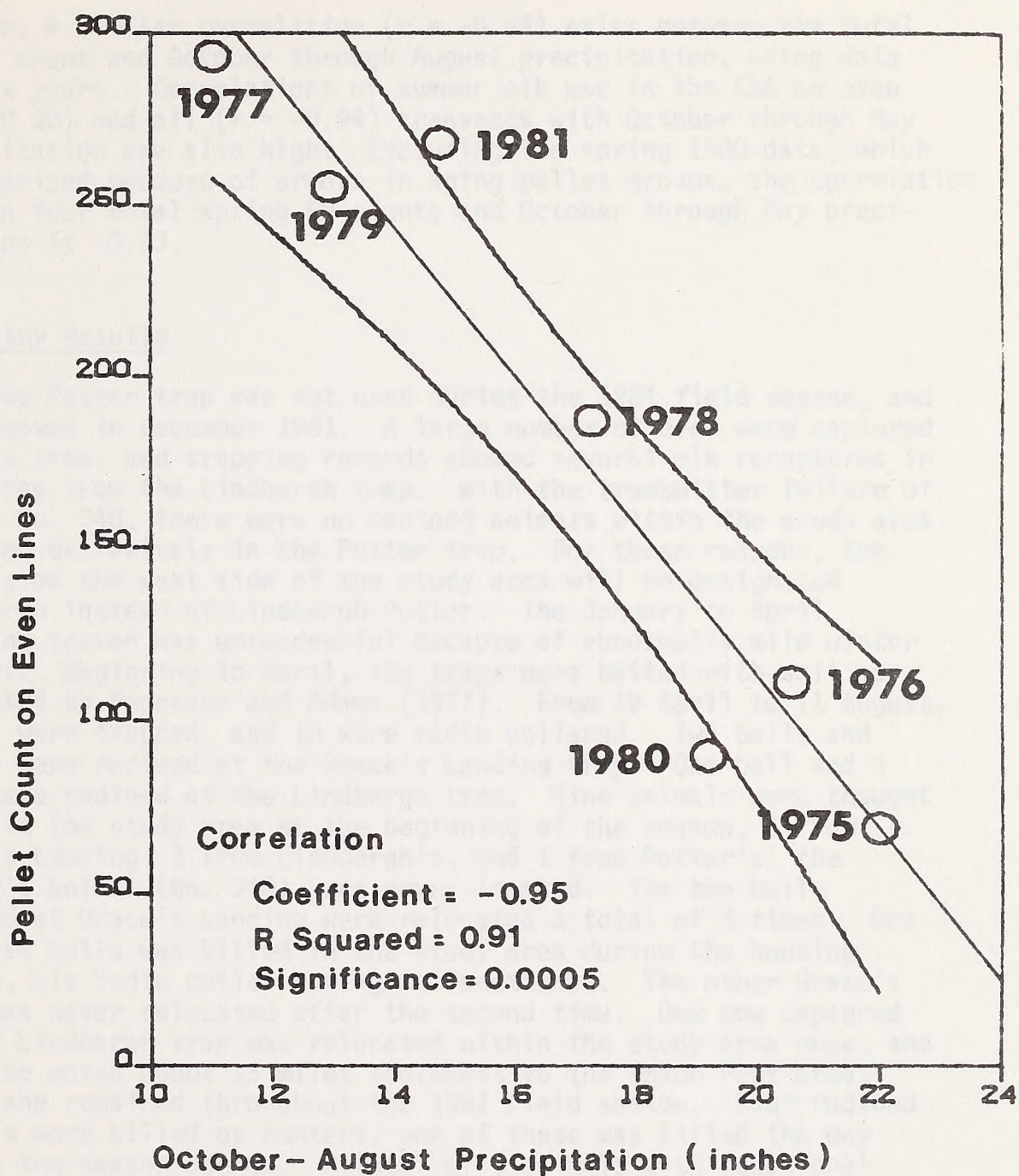


Figure 12. Linear regression of yearly summer pellet counts in the CSA against annual precipitation.

However, a similar correlation ($r = -0.94$) exist between the total pellet count and October through August precipitation, using data for six years. Correlations of summer elk use in the CSA on even ($r = -0.90$) and all ($r = -0.94$) transects with October through May precipitation are also high. Excluding the spring 1980 data, which were revised because of errors in aging pellet groups, the correlation between four total spring FN counts and October through May precipitation is -0.93 .

Telemetry Results

The Potter trap was not used during the 1981 field season, and was removed in December 1981. A large number of deer were captured in this trap, and trapping records showed several elk recaptures in this trap from the Lindbergh trap. With the transmitter failure of animal No. 340, there were no radioed animals within the study area captured exclusively in the Potter trap. For these reasons, the animals on the west side of the study area will be designated Lindbergh instead of Lindbergh-Potter. The January to April trapping season was unsuccessful because of abnormally mild winter weather. Beginning in April, the traps were baited with salt as suggested by Pedersen and Adams (1977). From 19 April to 11 August, 14 elk were trapped, and 10 were radio collared. Two bulls and 4 cows were radioed at the Grace's Landing trap. One bull and 3 cows were radioed at the Lindbergh trap. Nine animals were thought to be in the study area at the beginning of the season, 5 from Grace's Landing, 3 from Lindbergh's, and 1 from Potter's; the Potter's animal (No. 340), was never located. The two bulls trapped at Grace's Landing were relocated a total of 3 times. One of these bulls was killed in the study area during the hunting season, his radio collar having malfunctioned. The other Grace's bull was never relocated after the second time. One cow captured at the Lindbergh trap was relocated within the study area once, and then she moved about 15 miles southwest to the Union Peak area, where she remained throughout the 1981 field season. Four radioed animals were killed by hunters, one of these was killed the day before the season opened. A total of 9 animals with functional transmitters remained in the study area at the end of the 1981 hunting season.

A total of 38 flights between 23 May and 30 November resulted in 438 aerial locations of 15 cow and 3 bull elk. Visual observations accounted for 48% of these locations. Only the locations for cow elk were used for habitat use and distribution analyses.

Distribution and movements. The CSA comprises 15% of the total study area, and received 31% (++) of the use from all radio collared elk from May to November. Use was greater than availability for all seasons, significantly greater during the summer rutting and hunting seasons. Use of the CSA differed by trap site. A greater proportion of the Grace's Landing elk were located within the CSA during all

seasons except the rut. The Lindbergh elk used the CSA less than availability during the calving season, but exceeded availability the rest of the field season. Use of the CSA was greatest during the rut for the Lindbergh elk and during the summer season for the Grace's Landing elk. The majority of May through November locations for the Lindbergh elk were west of the CSA (49%), and north of the CSA for the Grace's Landing elk (57%).

Home range polygons and seasonal total geographic centers of activity for each radioed animal are shown in Figs. 13 through 22. Statistics on distribution and movements for all radio collared elk are presented in Table 19. The total area used by all animals was approximately 72 square miles (18,800 ha) from May through November. Composite home range area for the Grace's Landing animals was 37.8 square miles (9,930 ha) and 37.9 square miles (9,850 ha) for the Lindbergh animals. Total home range size for individual elk range from 7.7 square miles (2,000 ha) to 28.0 square miles (7,280 ha) with an average of 14.6 square miles (3,800 ha). Seasonal average home range areas for all elk were the smallest during the calving season (1.2 square miles; 310 ha), and largest during the rut (6.5 square miles; 1,690 ha). Summer and hunting season home ranges averaged (5.4 square miles; 1,400 ha) and (2.0 square miles; 520 ha) respectively.

Mean distance moved between successive locations increased from calving season (1.0 mile; 1.7 km) through rutting season (1.8 miles; 3.0 km), and then decreased during the hunting season (1.5 miles; 2.5 km). The May through November grand mean was 1.4 miles (2.3 km). The shortest mean movements between successive locations for individual elk was during the summer season (0.4 miles; 0.7 km), and the longest, 3.4 miles (5.7 km), occurred during the hunting season.

Maximum distance moved between successive locations followed the same pattern as the grand mean distances for all animals, except that the average maximum value was largest for the total May through November field season. The other values were: calving (2.1 miles, 3.5 km), summer (3.3 miles; 5.5 km), rut (3.9 miles; 6.5 km), and hunting (3.5 miles; 5.8 km).

Standard diameters (Lonner 1976, after Harrison 1958), as a second measure of home range size, followed the same pattern as the area measurement based on minimum area polygons. Average diameters for all elk increased from 1.9 miles (3.0 km) during the calving season to 3.6 miles (5.8 km) during the rut, and then decreased during the hunting season (3.1 miles; 5.0 km). The May through November standard diameter for all elk averaged 4.2 miles (6.7 km). Standard diameters for individual elk ranged from a minimum of 0.2 miles (0.3 km) during calving season to a maximum of 6.2 miles (9.9 km) during the rut.

LEGEND FOR
FIGURES 13-22

Home Range Polygons
15 May - 29 November 1981

Activity Centers

C = Calving, 15 May-15 June
S = Summer, 16 June-31 August
R = Rutting, 1 September-20 October
H = Hunting, 21 October-29 November
T = Total, 15 May-29 November

Grace's Landing Trap--Elk 11, 12, 131, 15, 25, 32, 38, 3101, 3111

Lindberg Trap--Elk 14, 16, 293, 33, 312

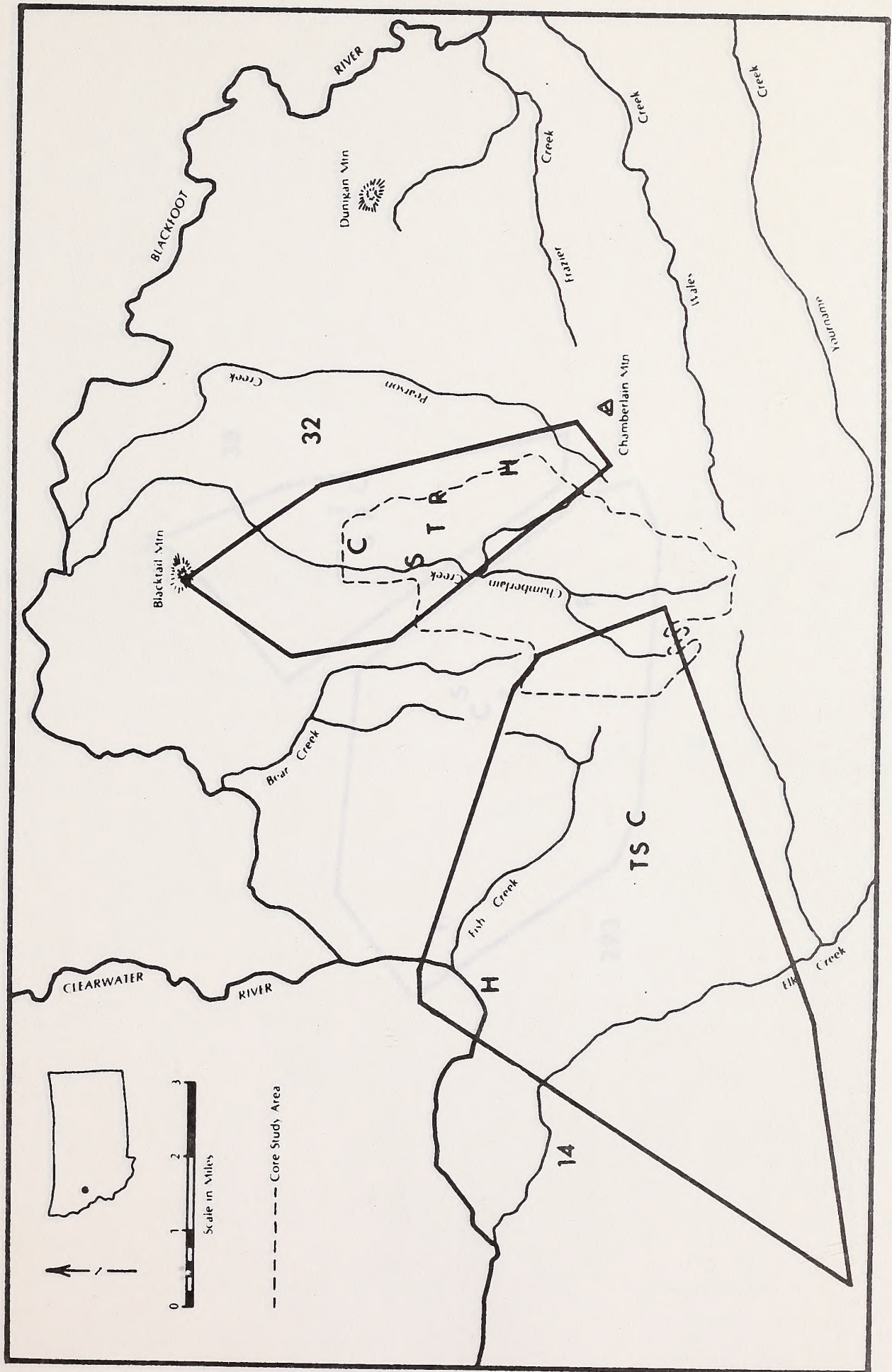


Figure 13. Home range polygons and activity centers for female elk 14 and 32.

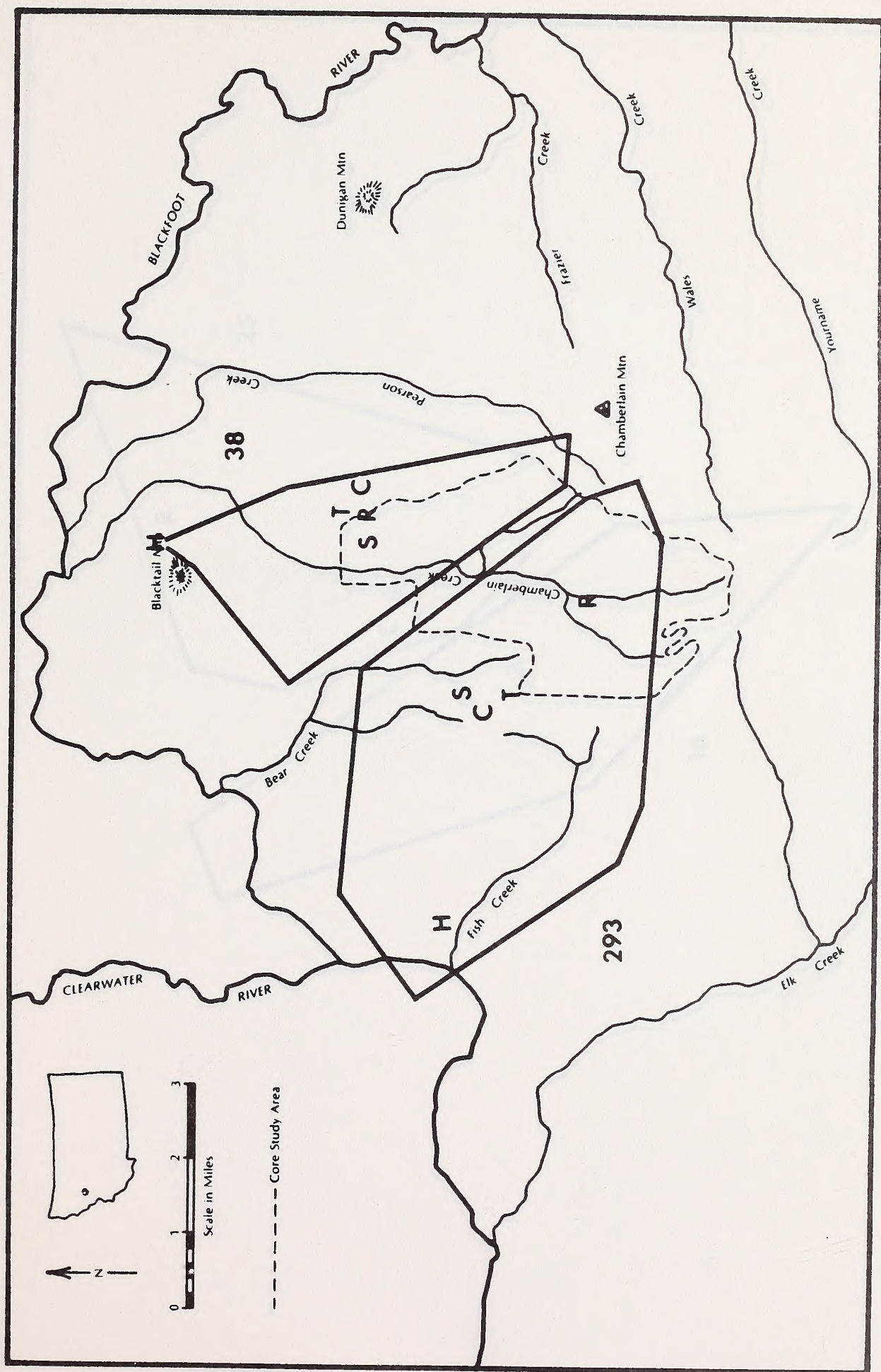


Figure 14. Home range polygons and activity centers for female elk 293 and 38.

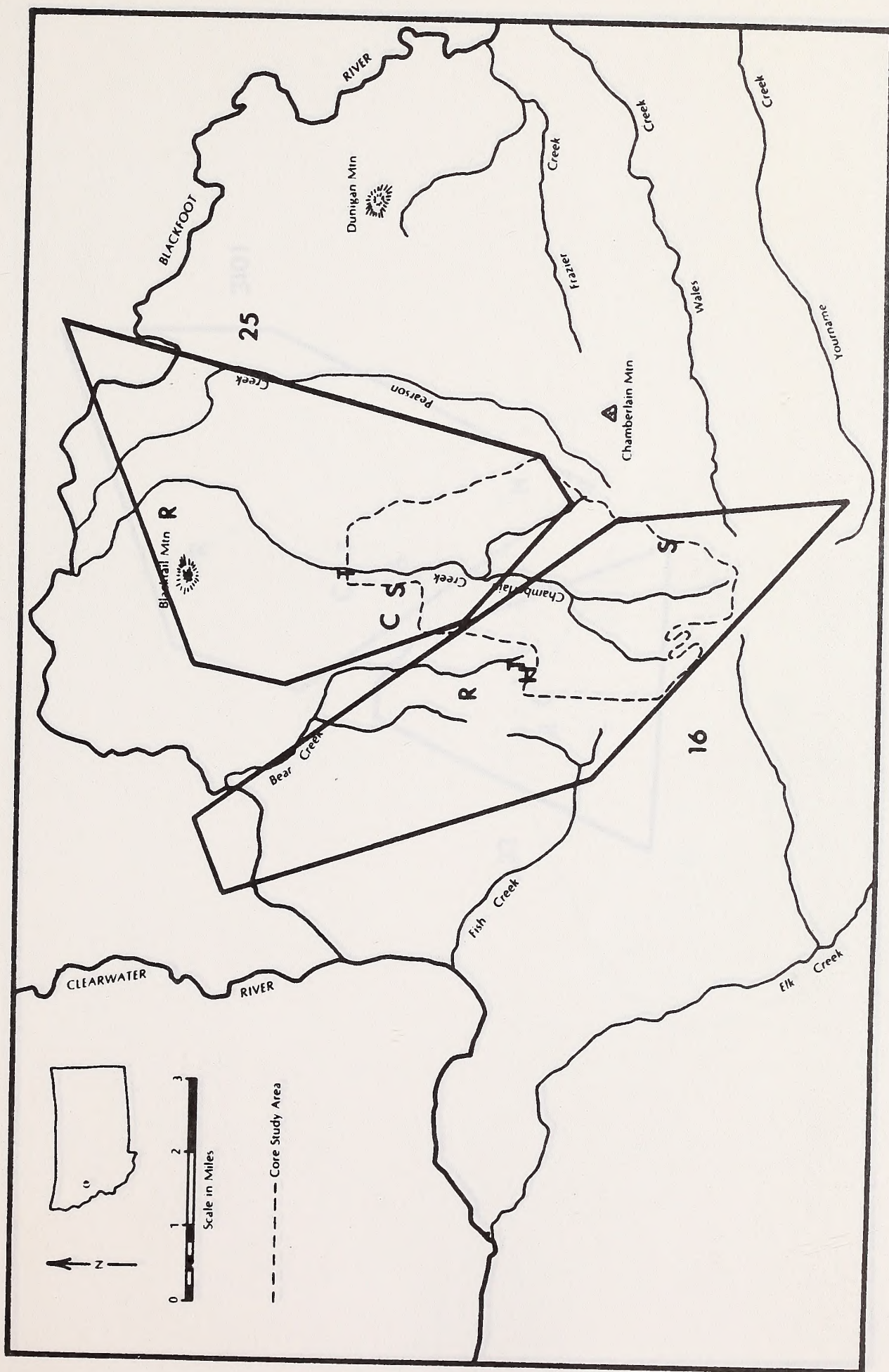


Figure 15. Home range polygons and activity centers for female elk 16 and 25.

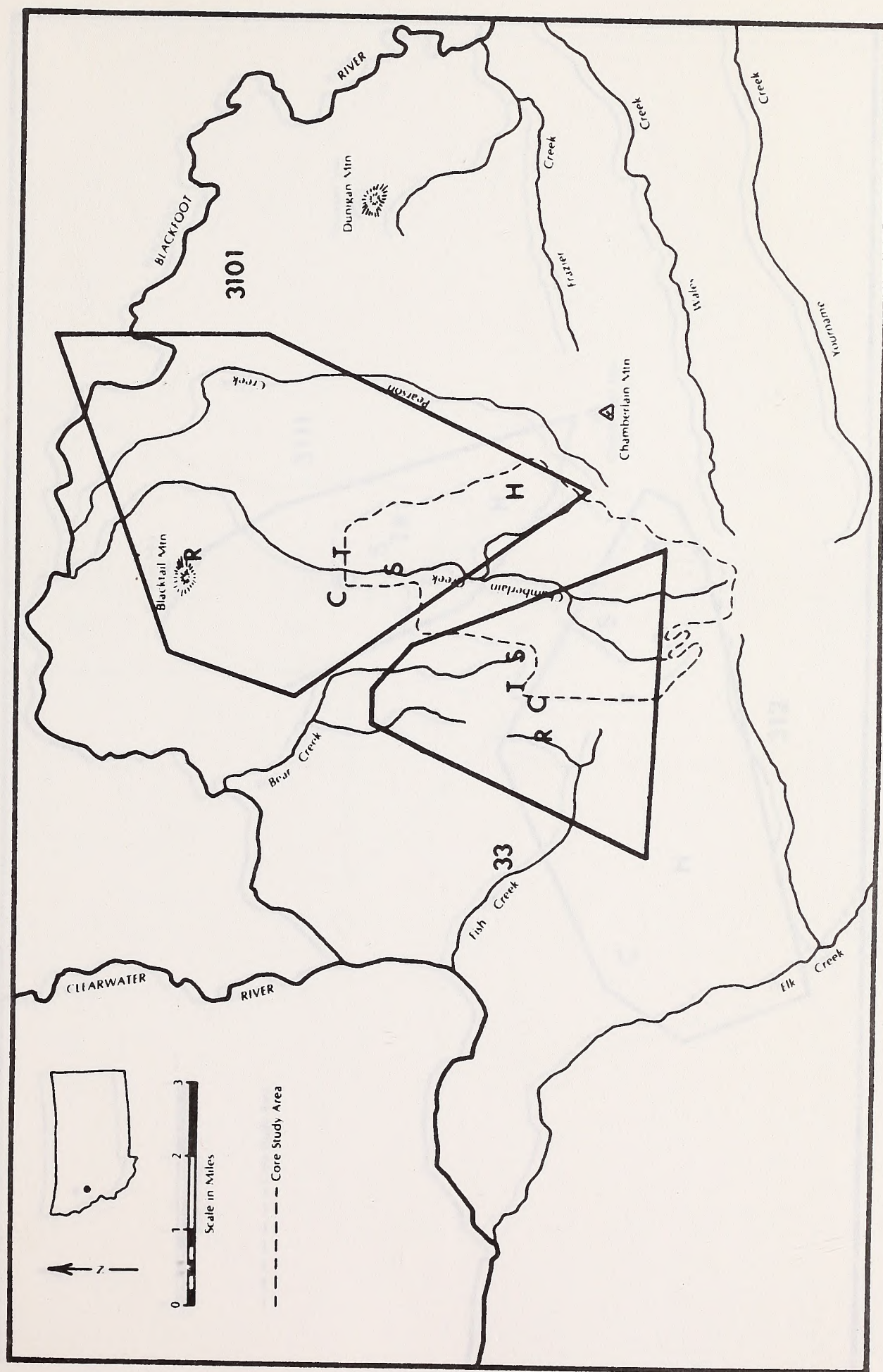


Figure 16. Home range polygons and activity centers for female elk 33 and 3101.

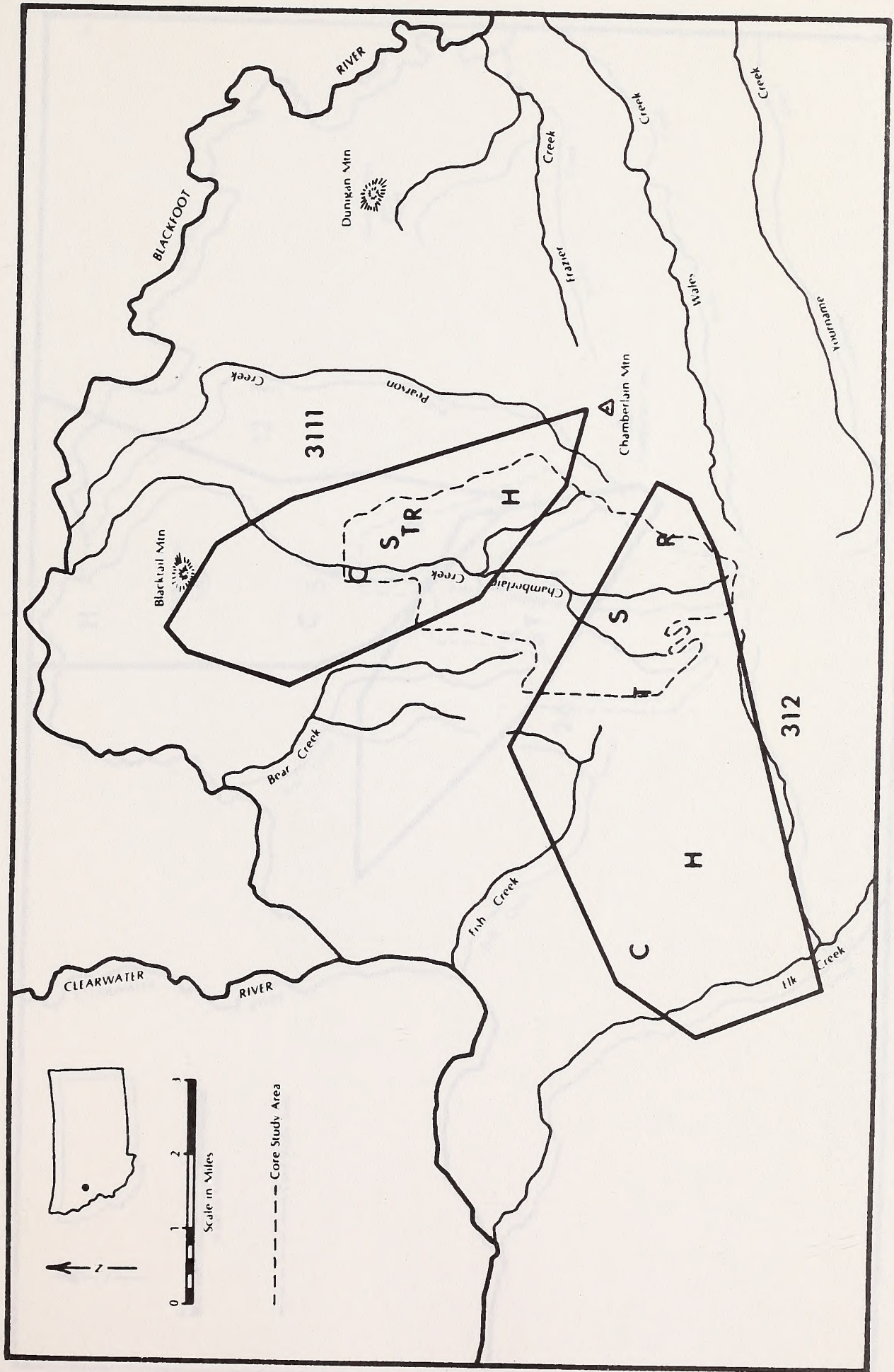


Figure 17. Home range polygons and activity centers for female elk 312 and 3111.

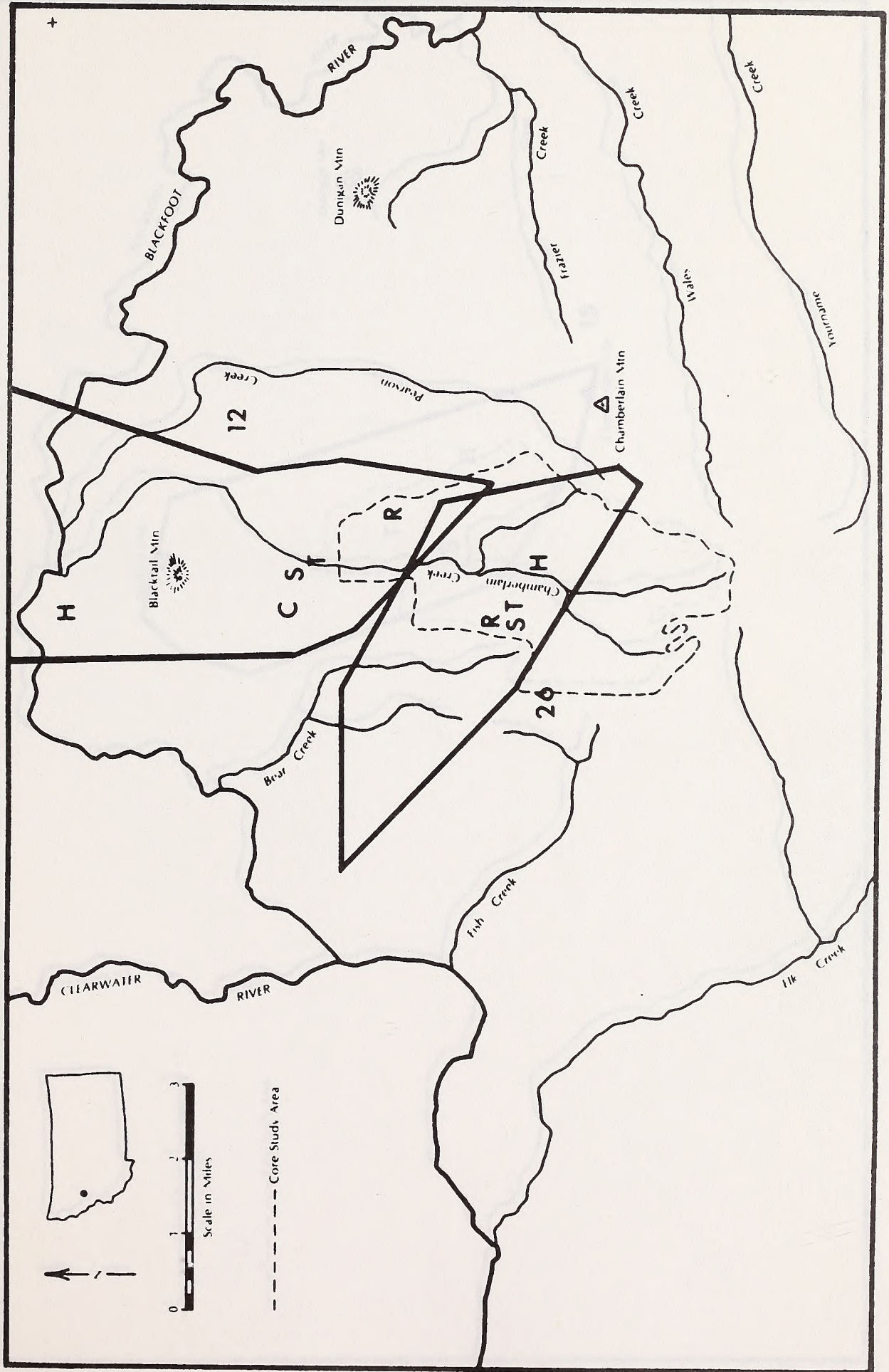


Figure 18. Home range polygons and activity centers for female elk 12 and male elk 26.

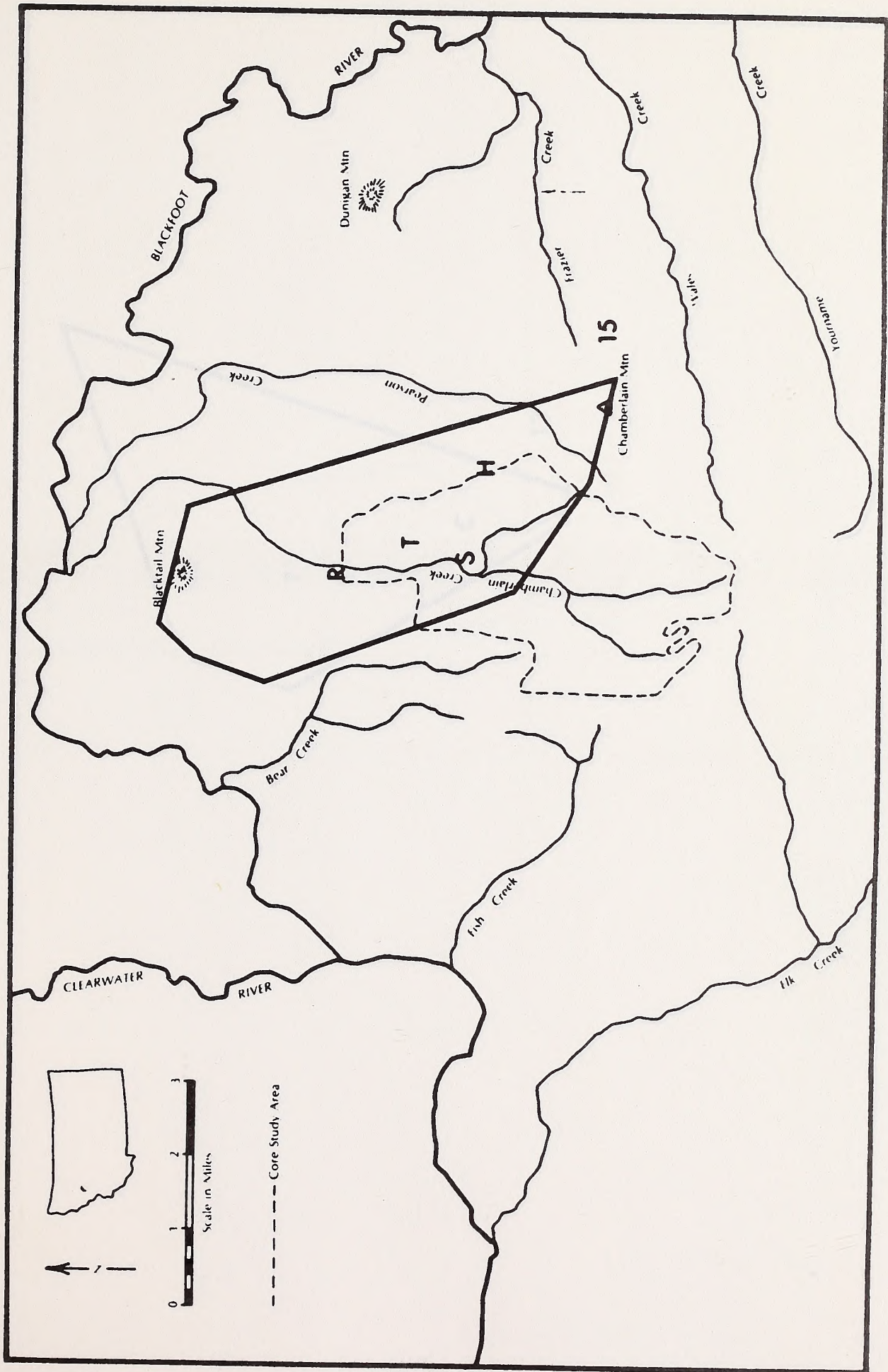


Figure 19. Home range polygons and activity centers for female elk 15.

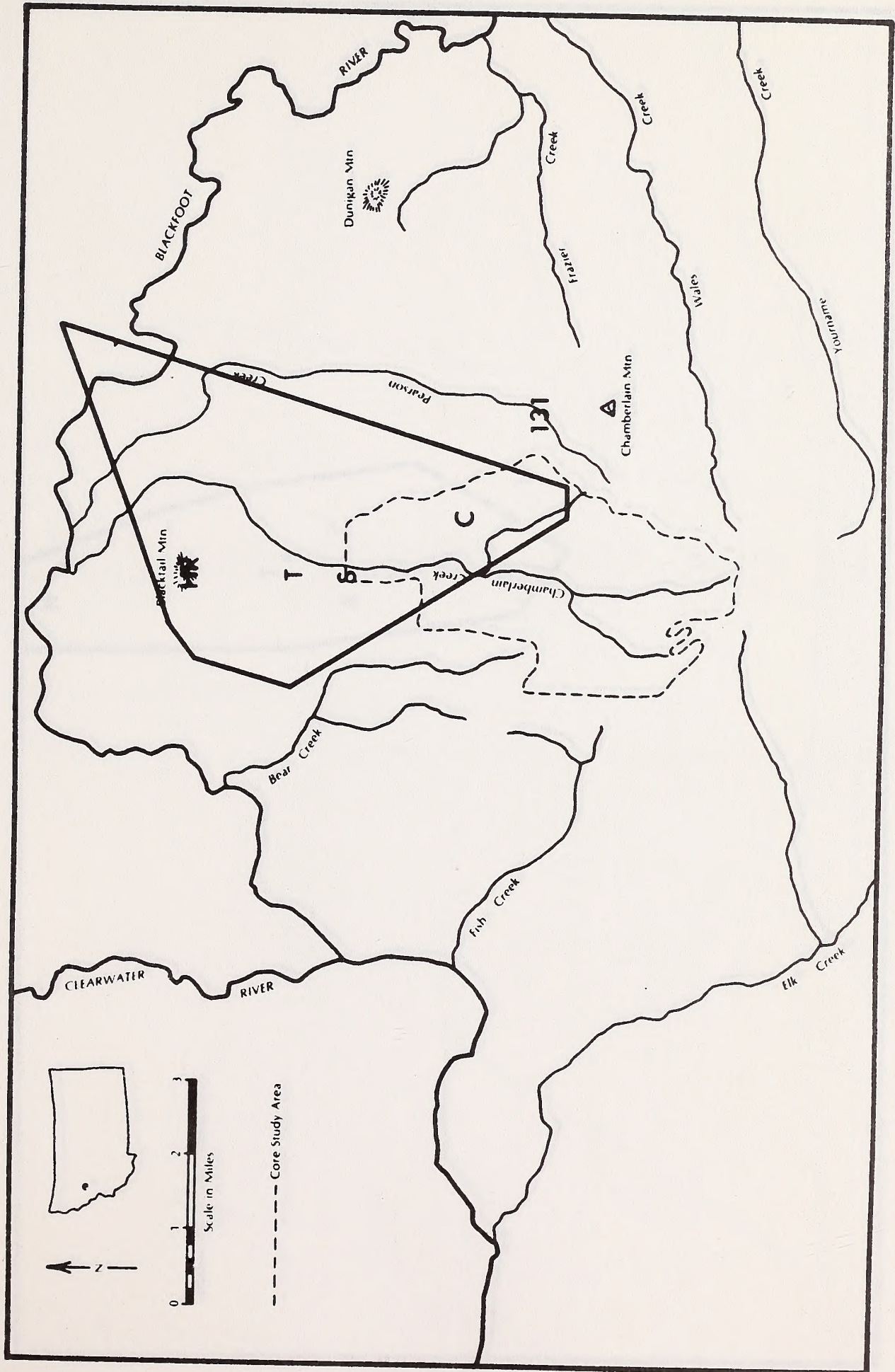


Figure 20. Home range polygons and activity centers for female elk 131.

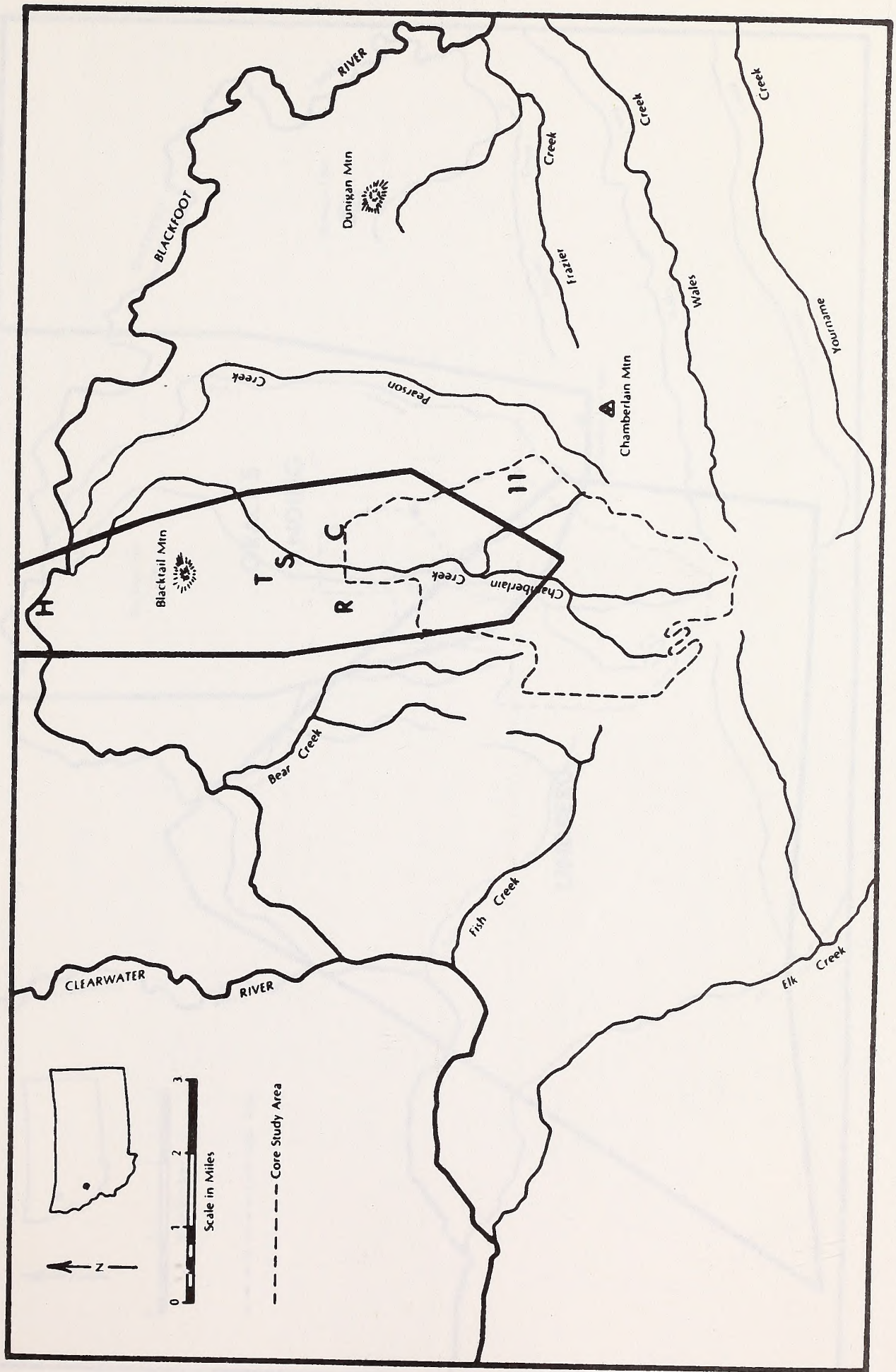


Figure 21. Home range polygons and activity centers for female elk 11.

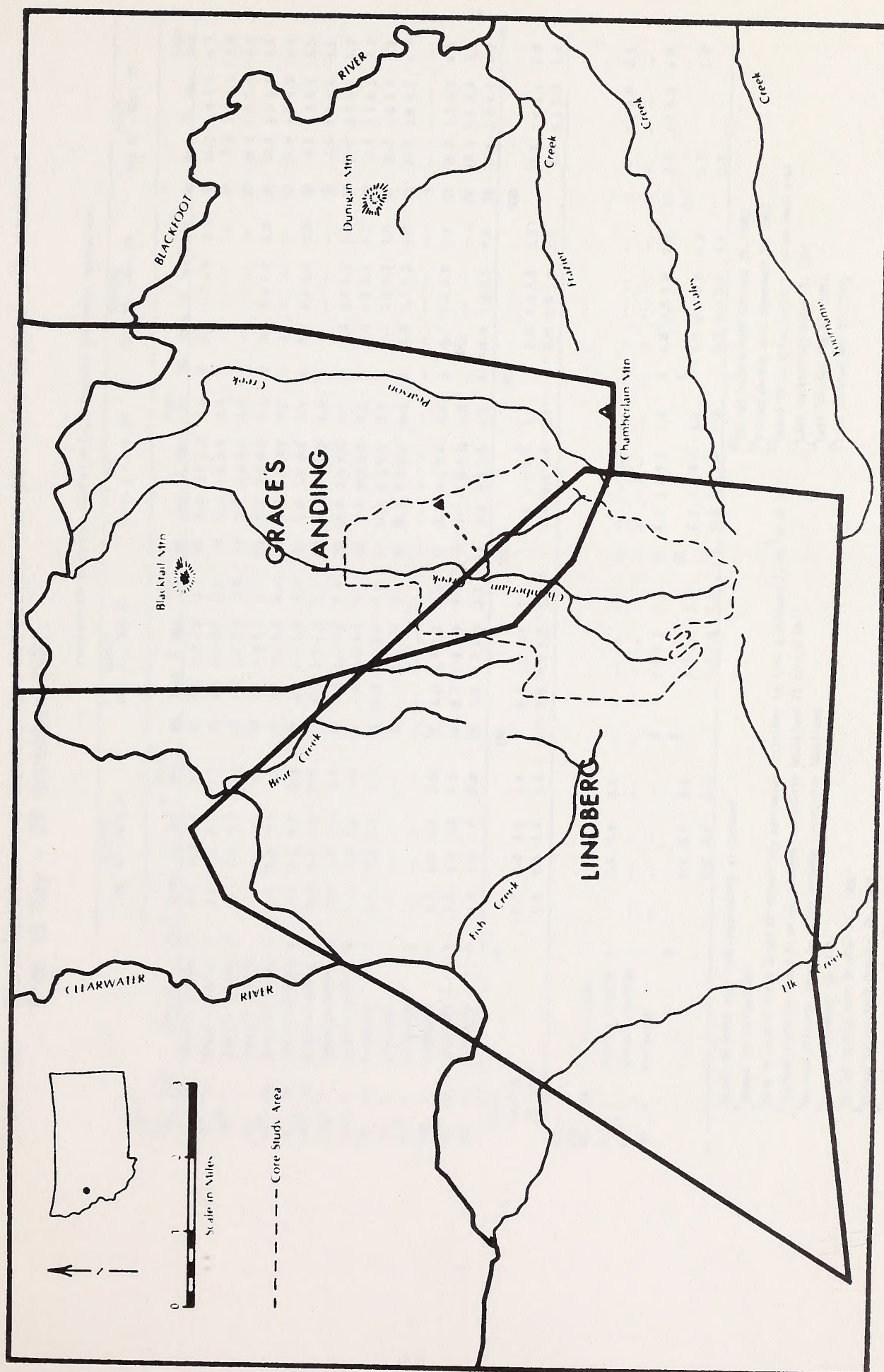


Figure 22. Composite home polygons for all radio-equipped elk by trap site, 1981.
 ▲ represents one location for one bull far outside its normal range.

Table 19. Distribution and movement statistics for 19 radio-tagged elk tracked from 15 May - 29 November 1981.

Location and distances (aerial miles), Seasonal and total relocations																												
		Calving				Summer				Rut				Hunting				Total										
		May 15 - June 15				June 16 - Aug. 31				Sept. 1 - Oct. 24				Oct. 25 - Nov. 29				May 15 - Nov. 29										
Female ELK No.	Age ¹	Trap Site	No. 2	Area 3		Max. 4	Stan. 5	No.	Area		Max. Dia.	Stan. Dia.	No.	Area		Max. Dia.	Stan. Dia.	No.	Area		Max. Dia.	Stan. Dia.						
11	5½	Grace's Landing	7	1.7	0.8	1.7	1.9	12	4.3	1.3	2.4	2.3	11	6.3	1.7	3.3	3.8	6	2.8	1.7	3.6	3.1	36	16.2	1.4	3.6	4.3	
12 ⁷	4½	Grace's Landing	7	1.7	1.2	2.1	1.7	13	4.0	1.2	2.5	2.2	10	3.3	1.0	2.4	2.3	1	--	--	--	--	31	7.8	1.2	3.1	3.0	
13 ⁸	4	Grace's Landing	4	--	0.2	0.2	0.2	12	7.8	1.7	5.6	3.9	11	2.1	2.0	5.2	3.0	1	--	--	--	--	28	16.2	1.5	5.6	4.2	
15	?	Grace's Landing	-	--	--	--	--	10	5.7	1.3	3.1	3.7	11	9.3	3.0	4.5	4.1	5	4.0	3.4	6.2	4.5	26	13.6	2.5	6.2	4.6	
25 ⁹	6½	Grace's Landing	6	0.5	0.9	3.7	3.3	11	4.1	1.6	3.8	4.1	4	1.3	1.8	3.1	3.8	-	--	--	--	--	21	17.9	1.6	5.3	4.5	
32	5½	Grace's Landing	6	1.8	1.2	1.7	1.8	12	5.1	1.1	2.8	4.1	10	1.9	1.6	4.1	3.1	6	0.5	0.8	1.8	1.9	34	8.7	1.3	4.1	3.5	
38 ¹⁰	7½	Grace's Landing	6	0.2	0.5	1.2	0.9	11	6.1	1.5	2.7	3.8	7	2.3	2.4	5.2	4.3	1	--	--	--	--	25	7.7	1.6	5.4	3.6	
3101	1	Grace's Landing	3	0.2	1.2	1.9	1.7	13	6.2	1.4	4.1	4.3	10	11.0	2.5	4.8	3.7	6	0.3	0.8	1.3	1.0	32	15.7	1.6	5.2	4.7	
3111	1	Grace's Landing	4	1.4	1.2	2.0	1.9	12	7.4	1.3	4.1	4.1	10	2.8	0.9	4.1	3.3	6	0.3	1.0	2.9	2.2	32	9.8	1.2	4.1	3.7	
14	4½	Lindbergh	7	4.1	2.3	5.7	4.2	13	10.9	1.3	4.4	4.3	11	11.3	1.9	5.9	5.5	6	1.2	1.3	5.3	4.0	37	28.0	1.6	5.9	5.2	
16 ¹¹	1	Lindbergh	-	--	--	--	--	2	--	0.4	0.4	0.4	10	26.9	2.9	4.6	6.2	6	5.9	1.7	4.0	4.4	18	27.2	2.4	4.6	5.7	
17 ¹²	1	Lindbergh	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--	--	--	--	1	--	--	--	--	
293	3	Lindbergh	5	0.5	0.7	1.1	1.0	12	6.0	1.4	3.9	2.6	11	11.3	1.2	3.6	4.3	5	0.7	1.1	3.3	2.7	33	18.3	1.2	3.9	4.5	
33 ¹³	4½	Lindbergh	7	2.3	1.2	2.8	2.3	13	5.7	1.5	3.9	3.5	2	--	1.0	1.0	1.0	-	--	--	--	--	22	9.3	1.4	3.9	3.1	
312	4½	Lindbergh	5	1.3	1.0	1.6	2.4	-	10	2.0	0.7	3.0	3.7	11	1.8	0.8	1.2	1.5	6	7.3	1.6	3.6	4.4	32	17.8	1.0	4.1	5.2
Cases			68					156					129					55					408					
Average				1.2	1.0	2.1	1.9		5.4	1.2	3.3	3.3		6.5	1.8	3.9	3.6		2.0	1.5	3.5	3.1		14.6	1.4	4.5	4.2	
Std. Dev.				1.2	0.6	1.4	1.2		3.0	0.5	1.2	1.5		7.4	0.9	1.5	1.7		2.6	0.9	1.5	1.7		8.5	0.5	0.9	1.6	
Male ELK No.	Age	Trap Site																										
2101 ¹⁴	1	Grace's Landing	2		0.5	0.5	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	0.5	0.5	0.5	
471 ¹⁵	1	Grace's Landing	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	
26	2	Lindbergh	-	--	--	--	--	2	2.1	2.1	2.1	2.1	10	6.3	1.4	5.0	4.1	5	4.0	2.6	4.8	3.9	17	9.2	1.8	5.0	4.0	
			3					2	2.1	2.1	2.1	2.1	10	6.3	1.4	5.0	4.1	5	4.0	2.6	4.8	3.9	20	9.2			2.25	
				0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0		0.0		

The relative importance of the CSA is demonstrated by the total and seasonal geographic centers of activity. Of 55 seasonal centers of activity, 25 fell within the CSA. Six of 14 total centers of activity fell within this area. Use of the CSA, as indicated by total and seasonal centers of activity, was similar for the 2 trap sites; the Grace's Landing animals had 17 of 34 seasonal centers of activity, and 4 of 9 total centers of activity within the CSA. The Lindbergh animals had 8 of 21 seasonal, and 2 of 5 total centers of activity within the CSA.

Topographic factors. Elevations within the study area range from 3,800 feet to 6,800 feet (1,160-2,070 m). The majority of elk locations were between 4,500 feet and 6,200 feet (1,370-1,890 m) (Table 20). The lowest elevation interval, 3,800-4,400 feet (1,160-1,340 m), was used significantly less than availability for all seasons, and for the total May through November field season. Four other seasonal variations from availability were significant. During the calving season, use of the interval between 5,100 feet and 5,600 feet (1,550-1,700 m) significantly exceeded availability, while use of the highest interval, (6,300-6,800 feet; 1,920-2,070 m) was significantly less. Use of the 4,500-5,000 foot (1,370-1,520 m) interval was significantly greater than availability during the summer, as was the 5,700-6,200 foot (1,740-1,890 m) interval during the rut. Yearlong, use significantly exceeded availability in both the 5,100-5,600 foot and 5,700-6,200 foot intervals.

Table 20. Percentages of availability and elk use related to study area elevation, 1981.

Elevation feet (meters)	Availability N 300	% Elk Use					Total 397
		Calving 68	Summer 155	Rut 126	Hunt 48		
3,800-4,400 (1,160-1,340)	40.8	-- 5.9	-- 7.7	-- 6.3	-22.9	-- 8.8	
4,500-5,000 (1,370-1,520)	24.0	39.7	++41.9	19.0	16.7	31.2	
5,100-5,600 (1,550-1,700)	15.0	+38.8	18.7	26.2	20.8	+23.9	
5,700-6,200 (1,740-1,890)	14.3	20.4	17.4	++37.3	18.3	++24.4	
6,300-6,800 (1,920-2,070)	6.8	-- 0.0	14.2	11.1	20.8	11.6	

Table 21 presents the availability and elk use by slope, the majority of the study area is less than 16° . Areas of less than 16° slope were highly preferred, use significantly exceeded availability for all seasons and yearlong. Slopes between 16° and 30° were used significantly less than availability during the summer, rut and hunting seasons, as well as yearlong. Use of slopes greater than 30° was generally less than availability, significantly so during the summer season.

Table 21. Percentages of availability and elk use related to study area slope, 1981.

Slope	Availability N 400	% Elk Use				
		Calving 68	Summer 156	Rut 126	Hunt 50	Total 400
0- 15°	59.0	+73.5	++88.5	++83.3	++92.0	++84.8
16- 30°	34.0	22.1	--10.3	-- 9.5	-- 6.0	--11.5
> 30°	7.0	4.4	-- 1.3	7.1	2.0	3.8

Few significant deviations from availability were recorded for aspect during the 1982 field season (Table 22). During the calving season, northeast aspects were used significantly more than availability, while level areas were used significantly less. Use of level areas was also significantly below availability for the summer season. No use of southerly aspects was observed during the hunting season; a significant variation from availability. Use of level areas was significantly less than availability for the total, May through November, field season.

Percentages of availability and elk use by slope position is presented in Table 23. The majority of elk use was in drainage heads and on mid to upper slopes. Lower slopes were used significantly less than availability for all seasons except the hunting season, and for the total May through November field season. Use of upper slopes significantly exceeded availability during the calving and rutting seasons, and for the entire field season. Elk use of drainage heads was consistently above availability, significantly during each seasons, as well as, over all seasons. Use of drainage bottoms was significantly less than availability during the rut. During the rut, use of mid-slopes significantly exceeded availability.

Table 22. Percentages of availability and elk use related to study area aspect, 1981.

Aspect	% Availability N 400	% Elk Use				
		Calving 68	Summer 156	Rut 129	Hunt 50	Total 403
N	16.8	16.2	17.3	8.5	8.0	13.2
NE	9.5	+26.5	9.0	17.8	14.0	15.4
E	7.5	10.3	12.2	5.4	14.0	9.9
SE	4.8	4.4	7.1	7.8	4.0	6.5
S	2.8	1.5	3.8	3.1	-- 0.0	2.7
SW	9.8	4.4	10.3	11.6	4.0	8.9
W	13.5	10.3	10.3	17.8	6.0	12.2
NW	15.8	25.0	21.8	15.5	28.0	21.1
Level	19.8	-- 1.5	-- 8.3	12.4	22.0	--10.2

Table 23. Percentages of availability and elk use related to study area slope position, 1981.

Slope position	% Availability N 300	% Elk Use				
		Calving 68	Summer 156	Rut 129	Hunt 50	Total 403
Ridge top	9.0	7.4	7.7	6.2	6.0	6.9
Upper slope	22.7	+39.7	26.9	+37.2	28.0	+32.5
Mid-slope	21.3	19.1	28.8	+36.4	18.0	28.3
Lower slope	32.7	--10.3	--13.5	-- 2.3	18.0	-- 9.9
Drainage bottom	8.7	4.4	6.4	- 2.3	8.0	5.0
Drainage head	5.7	+19.1	++16.7	+15.5	+22.0	++17.4

Table 24 presents elk use relative to horizontal configuration along the slope contour. The majority of use was on convex and concave configurations. Straight configurations received significantly less use than availability during the calving and summer seasons, and for the total May through November field season. Use significantly exceeded availability for concave configurations during the calving season, and over all seasons. Undulating configurations received significantly more use than availability for the summer season.

Table 24. Percentages of availability and elk use related to horizontal configuration along the slope contour, 1981.

Horizontal configuration	% Availability N 300	% Elk Use				
		Calving 68	Summer 156	Rut 127	Hunt 50	Total 401
Convex	30.2	29.4	37.8	24.4	24.0	30.4
Straight	34.9	--17.6	--13.5	24.4	36.0	--20.4
Concave	26.1	+44.1	30.8	37.8	34.0	+35.7
Undulating	8.8	8.8	+17.9	13.4	6.0	13.5

Use relative to distance to water, generally corresponds to availability (Table 25). Areas less than 150 yards (140 m) from water were consistently used less than availability. Conversely, areas greater than 450 yards (410 m) from water consistently received more use than would be expected from availability figures. Areas less than 50 yards (45 m) from water were used significantly less than availability during the calving and hunting seasons, and over all seasons. Use of areas greater than 550 yards (500 m) from water were used significantly above availability during the summer and rutting seasons, and over all seasons.

Table 25. Percentages of availability and elk use related to distance to water, 1981.

Distance to water yards (meters)	% Availability N 400	% Elk Use				
		Calving 68	Summer 156	Rut 127	Hunt 50	Total 401
0-50 (0-45)	16.0	-- 4.4	14.7	-- 4.7	6.0	- 8.7
50-150 (45-140)	23.0	20.6	20.5	14.2	16.0	18.0
150-250 (140-230)	24.0	25.6	19.9	27.6	-- 8.0	21.7
250-350 (230-320)	15.5	19.1	14.7	18.9	+38.0	19.7
350-450 (320-410)	12.5	14.7	10.9	11.0	14.0	12.0
450-550 (410-500)	5.3	10.3	7.7	9.4	4.0	8.2
>550 (>500)	3.8	5.9	+11.5	+14.2	14.0	+11.7

Vegetative factors. Elk use of the study area relative to overstory canopy coverage (Table 26) followed a consistent pattern throughout the 1981 field season. The majority of use was in stands with 75-95% canopy coverage. This use significantly exceeded availability for each season, and over all seasons. Use of stands with 25-75% canopy coverage was consistently below availability, significantly so during the summer and rutting seasons, and for all locations. Use of stands with less than 25% canopy coverage was significantly less than availability during the hunting season.

Table 26. Percentages of availability and elk use related to study area overstory canopy coverage, 1981.

Overstory canopy cover	% Availability N 300	% Elk Use				
		Calving 66	Summer 156	Rut 127	Hunt 46	Total 395
OPEN	8.7	6.1	5.8	6.3	6.5	6.1
<25%	14.7	9.1	17.3	7.9	- 4.3	11.4
25-75%	38.1	27.3	-25.0	--16.5	21.7	--22.3
75-95%	29.1	++51.5	++47.4	++65.4	++60.9	++55.4
95-100%	9.4	6.1	4.5	3.9	6.5	4.8

Table 27 presents percentages of availability and elk use of the study area categorized by stand composition, age and canopy coverage. In general, use was proportional to availability over most categories. No locations occurred within the light to moderately stocked, mature to old mixed species stands during the calving season, this was a significant deviation from availability. Densely stocked mature to old, mixed species stands consistently received more use than availability, significantly so during the rut, and over all seasons. Moderately stocked pole to young aged, mixed species stands were consistently used less than availability, significantly over all seasons, and for each season except the calving season. Densely stocked pole to young aged, mixed species stands received more use than availability for each season, with a significant deviation shown during the calving season and, for the total May through November field season. No locations occurred in pasture-hayfields during the calving, summer, and rutting seasons; use of this category was significantly less than availability for these seasons, and over all seasons. There were no locations on roads during the hunting season, a significant deviation from availability.

Table 27. Percentages of availability and elk use related to habitat age, species composition and canopy coverage, 1981.

Age, species, canopy cover*	% Availability N 300	% Elk Use				
		Calving 67	Summer 156	Rut 126	Hunt 46	Total 395
Mature-old mixed, light-mod.	3.3	- 0.0	0.6	2.4	4.3	1.5
Mature-old mixed, dense	3.3	7.5	3.8	++20.6	15.2	++11.1
Pole-young LPP, light-mod.	1.3	0.0	0.6	0.8	0.0	0.5
Pole-young LPP, dense	12.7	6.0	12.2	13.5	8.7	11.1
Pole-young mixed, light	9.4	6.0	11.5	7.1	4.3	8.4
Pole-young mixed, mod.	30.4	22.4	-17.9	--11.1	-13.0	--15.9
Pole-young mixed, dense	21.7	+43.3	30.1	31.0	39.1	++33.7
Brush-seedling-sapling	1.3	4.5	5.8	2.4	4.3	4.3
Dry meadow	1.7	0.0	0.0	4.8	0.0	1.5
Wet meadow	0.7	3.0	2.6	0.8	0.0	1.8
Pasture-hayfield	6.4	-- 0.0	-- 0.0	-- 0.0	6.5	-- 0.8
North slope clearcut	2.7	6.0	4.5	1.6	0.0	3.3
Road	3.0	1.5	5.1	4.0	- 0.0	3.5
Other**	2.0	0.0	5.1	0.0	4.3	2.5

* Canopy cover: light <25%; moderate 25-75%; dense >75%

**Other: brushy riparian, water, scree, rock

Use by habitat type (Pfister et al. 1977) is shown in Table 28. Use of habitat types was variable, but in general was proportional to availability with a few exceptions. Use of the pasture-hayfields habitat type was presented in the previous paragraph. Use of the

PSME/bunchgrass types was significantly less than availability for each season, and over all seasons. The same was true for the PSME/VACA habitat type, except during the hunting season. During the summer and rutting seasons, and over all seasons, elk use was significantly less than availability for the PSME/SYAL habitat type. Summer use of the PSME/CARU habitat type significantly exceeded availability. Use of the ABLA/XETE-VAGL habitat type was significantly greater than availability during the rut and over all seasons. The ABLA/XETE-VASC habitat type received significantly more use than availability over all seasons, and for each season except the calving season.

Table 28. Percentages of availability and elk use related to study area habitat types, 1981.

Habitat types	% Availability N 300	% Elk Use				
		Calving 68	Summer 156	Rut 127	Hunt 50	Total 401
Dry meadow	1.7	0.0	0.0	4.8	0.0	1.5
Wet meadow	0.7	2.9	2.6	0.8	0.0	1.8
Pasture-hayfield	6.3	-- 0.0	-- 0.0	-- 0.0	6.0	-- 0.8
Brushy riparian	1.0	0.0	5.2	0.0	2.0	2.3
North slope clearcut	2.7	5.9	4.5	1.6	0.0	3.3
Road	3.0	1.5	5.2	4.0	- 0.0	3.5
PSME/Bunchgrass	5.0	-- 0.0	-- 0.0	-- 0.0	-- 0.0	-- 0.0
PSME/VACA	13.0	-- 0.0	- 4.5	-- 2.4	12.0	-- 4.0
PSME/PHMA	2.3	7.4	3.9	4.8	2.0	4.5
PSME/VAGL	0.7	1.5	1.3	1.6	2.0	1.5
PSME/LIBO	10.7	17.6	18.1	7.9	8.0	13.5
PSME/SYAL	18.0	8.8	-- 2.6	-- 1.6	6.0	-- 3.8
PSME/CARU	8.7	8.8	++22.6	11.1	8.0	14.8
ABLA/CACA	2.7	0.0	0.6	1.6	2.0	1.0
ABLA/LIBO	4.3	16.2	0.6	8.7	10.0	7.0
ABLA/MEFE	10.7	13.2	10.3	10.3	18.0	11.8
ABLA/XETE-VAGL	6.3	7.4	9.7	++27.0	14.0	++15.3
ABLA/XETE-VASC	0.7	8.8	+ 8.4	++11.1	8.0	++ 9.3
Other	1.5	0.0	0.0	0.8	2.0	0.6

Disturbance-relationships. Distance to the nearest site of active human disturbance was recorded for each radioed elk location. Whenever possible, distances were measured from elk locations to specific sites of human activity, such as logging and road construction as observed while tracking elk from the air. Otherwise, general areas of disturbance for discrete time periods were used.

In addition to the logging and road construction mentioned in the pellet results, several other disturbances occurred within the greater study area during 1981. From late May through June, a salvage operation was conducted on Blacktail Mountain above the junction of the West Fork and main Chamberlain Creeks. Beginning during the rutting season and continuing through the hunting season, several units were logged in the East Fork of Chamberlain Creek. Several small units were thinned on the west side of the study area throughout the 1981 field season. In addition to these logging disturbances and associated road use, two mines were in operation in the North Fork of Elk Creek throughout the 1981 field season.

Table 29 gives the distribution of elk locations with respect to logging and road building activities. It should be noted that it was impossible to separate hunter pressure from other types of disturbances. Use of areas less than 0.5 (0.8 km) miles from disturbance was significantly less than availability during the calving, summer and hunting season. Inversely, areas greater than 2 miles (3.2 km) from disturbance were used significantly more than availability during these same seasons. The 0.5 to 1.0 mile (0.8-1.6 km) interval was used significantly less than availability during the hunting season. Use significantly exceeded availability for the 1.0 to 1.5 mile (1.6-2.4 km) interval during the rut, and for the 1.5 to 2.0 mile (2.4-3.2 km) interval during the summer.

Elk locations in respect to distance to new roads within the CSA are presented in Table 30. Except for the hunting season, areas less than 150 yards (140 m) from a new road were used less than availability, significantly so during the summer, rut, and for the total May through November field season. Use of areas greater than 1,350 yards (1,230 m) from a new road was consistently above availability, except during the hunting season; during which no use was recorded. Significant deviations from availability for this interval occurred during the calving, summer, and over all seasons.

Use of the study area relative to open roads is presented in Table 31. In general, use was proportional to availability. However, some significant deviations occurred. During the rutting and hunting seasons the area less than 150 yards (140 m) from an open road received significantly less use than availability. Use of areas between 150 and 550 yards (140 and 500 m) from an open road was significantly less than availability during the rut. The 950-1,350 yard (870-1,230 m) interval received significantly less summer use than would be expected from availability.

Elk use in respect to logging history at the location is shown in Table 32. Use was consistently below availability for non-forested areas, significantly so for all seasons except the hunting season. Unlogged areas were always preferred, significantly so during the hunting season, and for the total May through November field season. Areas logged within the last decade were used significantly less than availability during the hunting season.

Table 29. Percentages of availability and elk use related to logging and road building activities in the study area, 1981.

Distance to activity in miles (km)	Calving		Summer		Rut		Hunt	
	Avail. N	Use 300	Avail. 300	Use 156	Avail. 300	Use 127	Avail. 300	Use 50
0.0-0.5 (0.0-0.8)	19.3	-- 0.0	24.3	-- 3.2	16.3	8.7	13.7	-- 2.0
0.5-1.0 (0.8-1.6)	16.3	14.7	16.3	14.1	16.0	11.8	16.0	-- 2.0
1.0-1.5 (1.6-2.4)	21.0	22.1	19.0	10.9	15.3	++32.3	16.7	12.0
1.5-2.0 (2.4-3.2)	19.7	17.6	20.3	++36.5	14.0	14.2	17.0	8.0
>2.0 (>3.2)	23.7	++45.6	20.0	++35.3	38.3	33.1	36.7	++76.0

Table 30. Percentages of availability and elk use related to distance to new roads in the CSA, 1981.

Distance to new road in yards (meters)	% Elk Use					
	% Availability N 55	Calving 36	Summer 69	Rut 53	Hunt 19	Total 177
0-150 (1-140)	56.4	33.3	--13.0	-28.3	63.2	--27.1
150-550 (140-500)	25.5	19.4	20.3	35.8	- 5.3	23.2
550-950 (500-870)	10.9	5.6	10.1	15.1	15.8	11.2
950-1,350 (870-1,230)	3.6	5.6	7.2	7.5	15.8	7.9
>1,320 (>1,230)	3.6	++36.1	++49.2	13.2	0.0	++30.5

Table 31. Percentages of availability and elk use related to distance to open roads, 1981.

Distance to open roads in yards (meters)	Calving		Summer		Rut		Hunt	
	Avail. N	Use 300 68	Avail. 300	Use 156	Avail. 300	Use 127	Avail. 300	Use 50
0-150 (1-140)	15.0	17.8	14.7	14.1	10.7	3.9	5.3	-- 0.0
150-550 (140-500)	25.3	25.0	23.7	26.3	20.0	-10.2	11.7	14.1
550-950 (500-870)	15.3	14.7	16.3	16.0	14.7	18.1	9.7	6.0
950-1,350 (870-1,230)	8.3	14.7	9.0	-- 1.9	9.7	13.4	9.0	4.0
>1,350 (>1,230)	36.0	27.9	36.3	41.7	45.0	54.3	64.3	76.0

Table 32. Percentages of availability and elk use related to logged areas, 1981.

Time of logging	% Availability		% Elk Use				
	N	300	Calving 68	Summer 155	Rut 128	Hunt 50	Total 401
1970-1981	14.9		20.6	21.9	12.5	-- 4.0	16.5
1960-1969	8.7		8.4	11.6	3.1	6.1	6.4
1950-1959	6.0		8.2	2.0	10.8	7.0	7.0
Pre-1949	33.9		32.8	32.2	28.9	27.9	30.3
Unlogged	26.9		30.0	32.3	41.6	+49.0	++38.1
Non-forested	9.7		-- 0.0	-- 0.0	- 3.1	6.0	-- 1.7

Relative Hunter Use and Elk Harvest

The study area is largely within the Blackfoot Special Management Area (BSMA), where roads are closed to public vehicles from 1 September through 1 December. It is in Hunting District (HD) 292 where archery hunting for either sex elk was allowed from 5 September through 18 October 1981. The general elk hunting season for antlered males and for either sex by permit only ran from 25 October through 29 November. As in 1979 and 1980, the number of either sex permits issued in 1981 was 75, and they were valid only in the eastern part of H.D. 292.

Information concerning hunter use and elk harvest was obtained by the Montana Department of Fish, Game and Parks at the Bonner check station (Hartkorn 1982), by BLM workers, and by personnel of the Chamberlain Creek Elk-Logging Study through contacts with area hunters. The Bonner check station monitors an area larger than H.D. 292, but information on hunter trips through the station provides trends in hunting intensity for the general area. Since 1978, when hunter compliance with mandatory stops at check stations increased through better enforcement, hunter trips increased from 4876 to 6935 in 1981. Values for 1979 and 1980 were 4879 and 6012 hunter trips respectively. The known number of elk harvested in and near the BSMA increased from 50 in 1978 and 1979, to 75 in 1980, and 79 in 1981. Most of this increase was in animals taken south and east of the BSMA, but still in H.D. 292. Some of the increase is a result of better elk harvest information, but the elk population in that area does seem to be increasing. The number of elk taken within the BSMA has been less variable, with 39 harvested in both 1978 and 1981, and 43 in 1980. Twenty-nine elk were killed in the BSMA during 1979. Of the 79 elk harvested during 1981, 52 (66%) were males (26 spikes and 26 branch antlered), 23 (29%) were females, and 4 (5%) were calves.

DISCUSSION

We have now acquired six years of summer pellet count data on all transects in the core study area (CSA). There have been large yearly variations in the intensity of elk use of the CSA. However, some fairly predictable patterns of habitat selection and use by elk within the CSA have been revealed.

Since 1978, fall elk use in the CSA has been evaluated using the OVO pellet count from the following spring. By the middle of September or early October elk use usually increases on more xeric habitats, which are more common outside the CSA. In falls when the weather is unusually warm this change in use may be delayed. Patterns of fall habitat use by elk in the CSA have been similar and not highly selective, though the level of use has varied. For all three falls use has been greatest on gentle (0-15°) mid-slopes or secondary upper slopes and ridges, on westerly aspects, and at elevations

of 5,700-6,200 feet (1,740-1,890 m). Fall elk use of areas with understories dominated by (Vaccinium scoparium) grouse wortleberry was significantly less than availability, and use of bunchgrass understories in the PSME/CARU-AGSP habitat type was greater than availability. During the relatively mild fall of 1979, use of dense tree stands and old successional stages was greater than during the falls of 1978 and 1980.

Spring habitat selection and use by elk in the CSA varied with yearly moisture. During the drought year of 1977, spring elk use was greatest in southern subunits at upper elevations (>5,700 feet, 1,740 m), gentle slopes (0-15°), and in young stands of medium to large lodgepole pine in subalpine fir habitat types with mesic understory species. Conversely, during the relatively wet springs of 1978 and 1980 elk preferred northern subunits at lower elevations (<5,700 feet, 1,740 m), moderate to steep slopes (16-38°), and old stands of large Douglas-fir in Douglas-fir habitat types with more xeric understory species. Spring 1979 was intermediate in wetness, and the patterns of habitat use by elk in the CSA were similarly intermediate to those of the drier and wetter years. The months of May and June 1981 were wet in an otherwise dry year, and spring elk use was similar to that during the wet years. For all five years considered, spring habitat use by elk in the CSA has been similar for some habitat components. Use has been consistently less than availability for areas greater than 450 yards (410 m) from water, and areas with an understory dominated by grouse wortleberry. Elk use was always greater than availability on areas with less than 25% overstory canopy cover, including clearings; sight distances of greater than 100 yards (91 m); and old successional stages. Spring habitat use patterns by elk have been more selective during wet springs. Although significance tests are somewhat influenced by sample size, spring elk use varied significantly from availability for 26 habitat components in 1978 and 34 in 1980, as compared to 10 and 16 significant differences during the dry years of 1979 and 1977. As noted previously, 1981 was a wet spring in an otherwise dry year, and there were 26 significant differences.

Summer habitat use in the CSA by elk, as determined by pellet counts, has also been strongly influenced by yearly weather variations. During summer months, elk use increased in the more mesic habitats at higher elevations with greater overstory canopy coverage, relative to spring use. However, patterns of relative elk use during moist summers resembled the use patterns during dry springs, except for the increased use of areas with greater overstory canopy coverage in summer. Spring and summer habitat uses differed in that during summer the animals tended to be more selective during dry years than during wet ones, whereas in spring the reverse was true. During the drought year of 1977, elk use of 46 habitat components was significantly different from availability, and 26 differences were recorded in summer 1981. During the wet years of 1976, 1978, and 1980 significant differences in the use of habitat components ranged from only 8 to 12. The validity of this conclusion is reduced somewhat, in that only 10 significant differences were found during summer 1979, a dry year.

The patterns of summer habitat use by elk in the CSA have been similar in many ways throughout the study. This has been especially true for categories of abiotic variables such as elevation, slope, aspect, topography and distance to water. However, it was also true for many of the vegetative habitat categories. The greatest yearly differences in elk use of the CSA were in the total use, and in the relative selectivity of mesic plant communities. During dry years, elk move to moist, high elevation areas in the CSA earlier, and stay longer. Whereas, in wet years they remain more dispersed in more xeric, lower elevation habitats. Summer elk use of the CSA during the drought year of 1977 was approximately 3 to 4 times greater than during the wet years at 1975, 1976, and 1980. A high correlation between precipitation and elk use in the CSA has been established. This result remains after adding the 1981 pellet count data. In fact, summer 1981 elk use in the CSA was slightly higher than expected, even though human disturbance in the area was more intense than in any previous year. This may have been a result of a slight increase in the elk population in the area, following 3 relatively easy winters.

The levels of human activity in the CSA have gradually increased since the study began. During 1976 and 1977, no road building or logging activities occurred. There were only low levels of intermittent road building in the CSA during 1978 and 1979, and moderate levels of both logging and road building during 1980. In 1981, the area sustained the highest levels of human activity since the beginning of the study, especially during the summer months. However, disturbance was not uniformly high throughout the CSA, but moved from one subunit to another as work progressed.

In previous years, work has stopped in the CSA just prior to the opening of the general hunting season. However, in fall 1980 spur road building (on the east side of the area) and logging (in BN units 3 and 5) continued through the hunting season. Fall 1980 elk use of the CSA declined somewhat compared to fall 1979, but was almost twice the use of fall 1978, when there was even less disturbance. Use did not vary significantly from availability for any distance to disturbance category in fall 1980. Elk use in subunit 8, where the logging occurred, was significantly greater than availability, and use specifically on BN cutting units 3 and 5 was approximately 1.5 to 3 times as great as elk use on the CSA as a whole. Similarly, during spring 1981 elk use was significantly greater than availability in subunit 8, where new spur roads were being constructed, and there was no significant avoidance of areas near roads or cutting units. During summer 1981, when logging and road building activities were greatest, elk in the CSA avoided areas within 150 yards (140 m) of new roads (which are now the same as proposed roads), and proposed cutting units. These results indicate that Chamberlain Creek elk were displaced by heavy logging and road building activities that were sustained through an entire season. They also indicate that short term displacements of elk by limited or intermittent activities did not last long, or that elk used disturbed areas on nights and/or weekends, when humans were not there. The pellet count technique is less valuable than the telemetry technique, which is more time specific, in detecting elk movements in response to disturbance.

Although road building and logging activities in the CSA have increased considerably since 1978, the pellet count data indicate that the primary factors which have influenced habitat selection and use by elk in the CSA, and total use of the CSA, have been a combination of weather influences and vegetative composition, structure, and phenology. This conclusion, reported prior to significant disturbance in the CSA (Scott 1978, and Marcum et al. 1979), has not changed with the levels of human activity in the area to date. Elk have been displaced by road building and logging activities, but they were displaced largely within the CSA, not outside of it. Also, the levels of human activity have not been great enough to change the patterns of habitat selection and use by elk. Elk make almost universal use of the available habitats in the CSA, and no individual component has been preferred throughout the study. However, elk use has been consistently less than availability on areas greater than 450 yards (410 m) from water, small diameter lodgepole pine stands (pole-sapling successional stage), and primary slopes and ridgetops. Use of steep slopes ($>30^\circ$) has also been less than availability, except during the fall and spring of wet years (1978 and 1980).

Telemetry results since 1977 were discussed by Lehmkuhl (1981) and in previous annual reports. Use of the CSA by radio collared elk was high during the 1981 field season, as was predicted by the strong negative correlation between use and annual precipitation (Marcum and Edge 1981, Lehmkuhl 1981). The CSA contains a large portion of the high elevation mesic sites within the study area, which are important elk habitat, especially during years of low precipitation. Use of the CSA was significantly greater than availability ($P < 0.01$) for all years except the 1980 field season, the wettest year for which telemetry data were collected. Seasonally, this relationship varied somewhat throughout the study. Use of the CSA during the calving season has always approximated availability. During the drier 1977, 1978, 1979, and 1981 field seasons, use significantly exceeded availability during the summer season. Use during the rutting season was significantly above availability only for the 1979 and 1981 field seasons. Use of the CSA during the hunting season significantly exceeded availability during the last 3 years. Because the CSA contains the most continuous, heavy cover, and is best insulated against hunter access (Lehmkuhl 1981), this pattern is best explained by hunter pressure, which has increased yearly throughout the study. After 5 years, elk use of the CSA appears to be most dependent upon direct and indirect influences of annual weather variations. Annual or seasonal use of the CSA is thus far an inadequate indicator of the effects of logging on Chamberlain elk. Disturbance relationships have been more subtle, resulting in either a shift of elk use from area to area within the CSA, or a shift in the type of habitats used within an area.

Seasonal values for distribution and movement statistics varied from year to year. No seasonal patterns in home range area were evident for the 5 years of telemetry study. Mean home range area for the 1981 field season was intermediate to the other years for all seasons. Mean distances moved between successive locations were

quite similar for each season throughout the study. The 1981 distance values were minimum values throughout the study. Radioed elk showed a general trend for remaining in relatively small areas for extended periods of time (1 month). This behavior may have been because animals concentrate in areas of preferred forage that are insulated from open roads, logging activity and hunter access. Mean distances moved were in general greatest during the rutting seasons, and smallest during the calving seasons. Maximum distances moved between successive locations followed a pattern similar to mean distance, with the longest movements occurring during the rutting seasons, and the shortest movements during the calving seasons. These seasonal differences in movement appear to be a function of reproductive biology. Movements are small during the calving season as a result of a strong fidelity to calving sites, and large during the rutting season; a function of harem formation. The 1981 distance moved values were intermediate to those of other years for each season. Seasonally, standard diameters were quite variable. In general, values were lowest during the calving season and highest during the rutting season. Again, the 1981 values were intermediate to the other years for each season.

Some yearly patterns were evident for the distribution and movement statistics during the 5 years. The 2 measures of home range size, area and standard diameter, were largest during the driest year, 1977, and smallest during the wet 1980 field season. No pattern was evident for the intermediate years, except that the values were quite similar in magnitude. Yearly mean and maximum distances moved followed a general pattern. Movements were shortest during the 1981 field season and longest during the dry 1977 field season; however, yearly values were quite similar in magnitude. Yearly differences in home range and movement statistics are probably a function of plant phenology and forage availability as affected by annual weather patterns, and differences due to the extent of disturbance. During drought periods, forage availability is reduced, causing elk to move more extensively in search of forage, resulting in an increase in both home range area and movement values. Elk normally range over a wide area, with variations in home range area, movements between individual animals, and for the same animal between seasons and years. However, Chamberlain elk generally show a high degree of home range fidelity in that year to year home ranges are similar in respect to spatial orientation. Seasonal centers of activity may show large or small shifts from year to year. Disturbances caused by logging and road construction could cause elk home range and movements to vary in 3 ways. First, an elk may drastically shift its home range away from an active disturbance, resulting in a low degree of home range fidelity. Second, an elk may maintain a high degree of home range fidelity but move more extensively because of repeated disturbance, resulting in an increase in area and movement statistics. This pattern might be expected during periods of wide spread disturbance. Third, during periods in which disturbances are localized, elk may be expected to maintain a high degree of home range fidelity, but shift activity centers away from sites of disturbance. A method for quantifying home range fidelity is being examined so that these relationships may be studied.

The 1981 field season reaffirmed the disproportionate use of the CSA by the 2 trap site groups. The Grace's Landing animals consistently used the CSA more than the Lindbergh animals throughout the 5 years. Composite home range by trap site continued to show very little overlap. Future logging activities within the CSA will probably impact the Grace's Landing animals to a greater extent than the Lindbergh animals.

Habitat utilization by radio collared elk from May through November was quite variable from 1977 through 1981. However, with respect to some variables a few patterns were apparent. Radioed elk consistently avoided (use significantly less than availability) elevations below 4,400 feet (1,340 m). Throughout the 5 years, the majority of locations were between 4,500 and 6,200 feet (1,370-1,890 m). The 5,100-5,600 foot (1,550-1,700 m) interval was highly preferred (use significantly greater than availability) for all years except 1977, during which the majority of use shifted to the next higher interval. This interval, 5,700-6,200 feet (1,740-1,890 m), was highly preferred during all years except the wet 1980 field season. Use of available elevations by Chamberlain elk from May through November is typified by a preference for higher sites. This preference appears to be a function of elk selecting for succulent forage and avoiding disturbances, which in general, occur at low to mid-elevations. Elk preferred areas of less than 16° slope during the 1979, 1980, and 1981 field seasons, and avoided areas between 16° and 30° slope during the 1980 and 1981 field seasons. No yearly patterns in elk use by aspect were evident, except for a general avoidance of level areas which are typified by low elevation hayfields. Use of slope position was quite variable. This may in part be due to the subjective nature of the position classification, especially in respect to what constitutes a drainage head. Analyses from 1977 through 1979 considered the drainage head classification to be more limited than did the analyses for the last 2 years. However, the majority of locations were on mid to upper slopes, with lower slopes consistently used less than availability ($P < 0.01$). Use by topographic configuration varied from year to year. Straight configurations were avoided all years except 1979. Use of convex configurations approximated availability all years except 1979, during which use was significantly less. A preference was shown for concave configurations during all years, significantly so during 1977, 1978, and 1981. Selection for succulent forage may account for this preference. Distance to water was quite variable, with only 2 general patterns emerging. The intervals between 150 and 450 yards (140-410 m) consistently received the majority of use. The areas greater than 550 yards (500 m) from water were preferred during all years except 1977. This does not seem unusual in a study area where 39 percent of the area is within 150 yards (140 m) of water.

May through November utilization of vegetative habitat factors showed a few patterns. The majority of use of overstory canopy coverage classes for all years was concentrated in the 25-75% and 75-95% cover classes. However, use of the 25-75% class was below

availability for all years, significantly below during 1979 and 1981. Use of the 75-95% class was above availability for all years except 1977, with significant positive deviations occurring during 1979 and 1981. Some general trends are apparent within the habitat age and composition classification. The densely stocked, mature to old aged, mixed species stands were highly preferred ($P < 0.01$) during 1978, 1979, and 1981. The densely stocked pole aged mixed species stands were preferred ($P < 0.01$) during 1979, 1980 and 1981. Dense lodgepole stands were consistently used less than availability, but differences were not significant. The pasture-hayfield class was always used less than availability ($P < 0.01$). In respect to Montana Forest Habitat Types (Pfister et al. 1977), the following patterns were evident. The PSME/bunchgrass types were always used less than availability, significantly during 1981. PSME/VACA consistently receives less use than availability, with significant deviations in all years but 1978. Use of the PSME/SYAL type is always below availability, significantly during 1977, 1979, and 1981. The PSME/CARU type received more use than availability during all years, with significance during 1980. ABLA/LIBO was preferred ($P < 0.01$) during 1979 and 1980, and use was always above availability. ABLA/XETE-VAGL was preferred ($P < 0.01$) during 1978, 1979, and 1981, and use was above availability during the other years. Year-round, radio elk seem to prefer the higher elevation mesic sites, with a general preference for mixed species stands of greater than 25% canopy coverage. These sites are probably selected because they provide the best combination of preferred forage and cover.

Habitat utilization on a seasonal basis was highly variable, yet some patterns were apparent. Use of the study area in respect to elevation shows some strong seasonal patterns. The 3,800-4,400 foot (1,160-1,340 m) interval was consistently avoided all seasons for all years, except during the rutting seasons of 1978 and 1980. During the calving season, the 5,100-5,600 foot (1,550-1,700 m) interval was preferred ($P < 0.05$) for all years. During the summer, the 5,700-6,200 foot (1,740-1,890 m) interval was preferred the first 3 years, whereas the 4,500-5,000 foot (1,370-1,520 m) interval was preferred the last 2 years. No pattern was apparent during the rutting season. During the hunting seasons, a preference was shown for the intervals between 5,100 feet (1,550 m) and 6,200 feet (1,890 m). There were no seasonal patterns in elk use in respect to steepness of slope or aspect during the study. Slope position showed a couple of general patterns which were expressed in the May through November analysis. Lower slopes were consistently avoided ($P < 0.01$) during all seasons of all years except during the 1981 hunting season. Mid and upper slopes and ridgetops consistently received the majority of use throughout all seasons, with a general trend from mid-slopes to upper slopes and ridgetops as the seasons progress. Secondary ridgetops received more use than primary ridgetops for the last 3 years. In respect to distance to water, a couple of seasonal patterns are shown. Distances greater than 550 yards (500 m) received more use than would be expected for each season. Areas less than 50 yards (45 m) have shown a general decrease in use over the past 2 years. Because many of the roads within the study area follow major stream courses, this avoidance may be a result

of the wide spread logging in 1980 and 1981, and the completion of CSA spur roads in 1981. In respect to topographic factors on a seasonal basis, elevation and slope position showed the strongest patterns. With the exception of the rutting seasons, use generally shifts from mid-elevations to higher elevations from calving to hunting seasons. Slope position is highly dependent upon elevation and therefore showed a similar trend. The exceptions to this occurred during the 1980 and 1981 field seasons in which slightly lower elevational preferences were shown, and during the rutting seasons, in which elk were found on a variety of slope positions and elevations. Calving and summer season elk use of topographic factors may be a function of elk using higher elevation sites for their more preferred succulent forage. Selection of sites based upon forage preferences appears to decline with the approach of the rutting season. During the rut, Chamberlain elk make broader use of available topographic factors. Elk again select for higher elevation sites during the hunting season, apparently because these sites are farthest from hunter access points.

Elk use of vegetative factors from season to season was also quite variable. Use in respect to overstory canopy coverage during the calving and summer seasons varied substantially. A general preference for moderate to densely stocked stands was apparent during the rutting seasons. During the hunting seasons, use of densely stocked stands has increased from 1977 through 1981. In general, habitat age and species composition trends were described in the May through November analysis with a strong avoidance ($P < 0.01$) of pasture-hayfields throughout all seasons, and the majority of use occurring in mixed species stands, pole to mature age. During the hunting seasons, a more specific trend was noted; dense, mixed species stands received the majority of use. This was in part due to elk avoidance of hunter pressure. Habitat utilization as determined by habitat type varied seasonally. Use was not significantly different than availability for any habitat type more than once within a particular season with the following exceptions. Use of the PSME/bunchgrass types was less than availability during the calving season for all years, significantly so during 1977, 1979, and 1981. Except for the 1978 rut, PSME/VACA was consistently used less than availability, with significant differences occurring during the 1979, 1980, and 1981 calving seasons; during the summers of 1977, 1979, and 1981, and during the 1977 and 1979 hunting seasons. Additional trends generally appear to be related to yearly weather patterns or hunting pressure. During the drought year of 1977, the more mesic higher elevation habitat sites were selected throughout that field season. A general shift to higher elevations and wetter habitat types occurred from calving to summer for all years. No pattern was evident during the rutting seasons. During the hunting seasons, a general preference was shown for higher elevation habitat types. Seasonal use of vegetative factors was difficult to separate from topographic factors, especially elevation. In general, more mesic sites were selected during dry years. Little preference in respect to vegetative factors occurred during the rut, but there appeared to be a preference for more dense stands during the hunting seasons.

Habitat use as related to disturbance factors showed several seasonal patterns. Availability values indicated that logging and road construction disturbances increased within the entire study area from 1978 to 1980, and then decreased during 1981, even though disturbance increased within the CSA. The high 1980 values resulted from widespread logging throughout the study area. The 1978 disturbance had little effect on the distribution of elk. No avoidance was shown of areas within 0.5 mile from logging and road construction during the calving seasons of 1979 and 1981. Elk use of this same interval was significantly below availability during the 1979, 1980, and 1981 summer seasons, as well as the 1979 and 1980 rutting seasons. Areas greater than 2 miles from these disturbances received significantly more use than availability during the 1981 calving season, during the summers of 1979 and 1981, the rut of 1979, as well as the 1980 and 1981 hunting seasons.

In regard to distances to new roads within the CSA, a preference was shown for distances greater than 1,350 yards (1,230 m). An avoidance of areas less than 150 yards (140 m) occurred during most seasons for all years, with a strong avoidance during the summer and rutting seasons this year. In 1981, all spur roads were completed and most were heavily used during the summer and rutting seasons. The very high use of the interval less than 150 yards (140 m) during the 1981 hunting season was because the roads were closed, and the majority of locations were from a group of elk that stayed near the new roads in subunit 8 most of the season.

Chamberlain elk demonstrated little avoidance of open roads during the calving and summer seasons, except during 1980 ($P < 0.01$). This was primarily due to road usage. During all years but 1980, the majority of roads received light (less than 1 vehicle trip/day) to moderate (1-4 vehicle trips/day) use. The widespread logging and road construction within the study area in 1980 greatly decreased the availability of areas within 150 yards (140 m) of an open road. Areas within 150 yards (140 m) of an open road were consistently avoided ($P < 0.01$) during the rutting and hunting seasons, and the interval farthest from an open road consistently received more use than availability.

Elk use related to logging history followed the general pattern described by Lehmkuhl (1981). Non-forested areas were always used less than would be expected during all seasons for all years. The majority of these areas are the lower elevation pasture-hayfields. Unlogged areas were generally preferred, especially during the rutting and hunting seasons. Areas logged prior to 1949 were generally used less than availability, especially during the hunting season. Because these areas are generally at lower elevations and closest to hunter access points, this avoidance seems reasonable.

Our telemetry study has now been conducted for 5 years, providing a large data base from which to evaluate elk habitat use. Elk are large generalist herbivores that range widely in search of adequate amounts of quality forage. Our results indicate that elk select from

available habitats based upon forage and cover preferences. These preferences show year to year changes related to annual weather variations, and are tempered by behavioral responses to human disturbances. Elk preferences based upon forage occurs most during the calving and summer seasons. Elk use a wider range of the available habitats during the rutting season, with an apparent preference for dense to moderately dense stands. During the hunting season, elk habitat selection appears to be strongly influenced by hunting pressure. Elk select for dense to moderately dense stands that are well insulated from hunter access points. During all seasons elk show a general avoidance of human disturbances. This is most obvious during seasons in which disturbances are widespread, such as 1980 and 1981. Elk select sites that are greater than 150 yards (140 m) from an open road, especially during the rutting and hunting seasons. A similar selection is shown for sites that are greater than 0.5 mile from logging or road construction. Seasons in which the last two relationships did not hold true were seasons during which the majority of roads were lightly traveled, or both road use and logging disturbances were generally localized or were conducted on lower elevation sites not used by elk.

The Blackfoot Special Management Area (BSMA) continues to provide recreational hunting to rather large numbers of hunters, especially on opening day. Most hunters seem to think the quality of hunting in the walk-in area as still fairly good. The known harvest increased from 50 to 75 animals between 1979, 1980, and was 79 in 1981. However, the harvest of females is limited, and the number of branch-antlered males taken equaled the number of spikes taken, so the number taken does not appear to be detrimental to the population. Also, part of this apparent increase may be merely a result of better information.

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Submitted by: C. Les Marcum
W. Daniel Edge

